OCTOBER 1960

Heating Piping & Air Conditioning

. . . for Consulting Engineers • Mechanical (Heating, Piping, and Air Conditioning) Contractors • Engineers with Plants and Big Buildings

ENGINEERING DATA FILE

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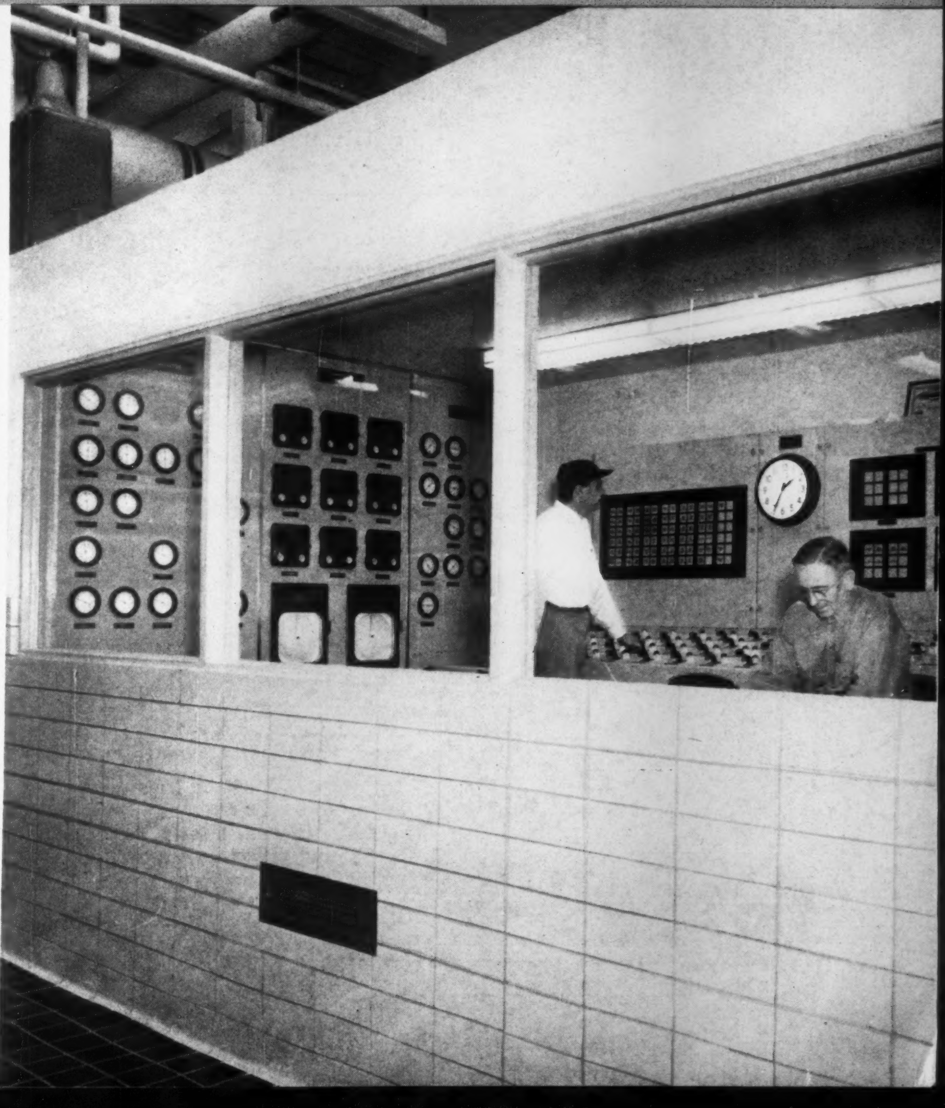

JENKINS PRACTICAL PIPING LAYOUT

83

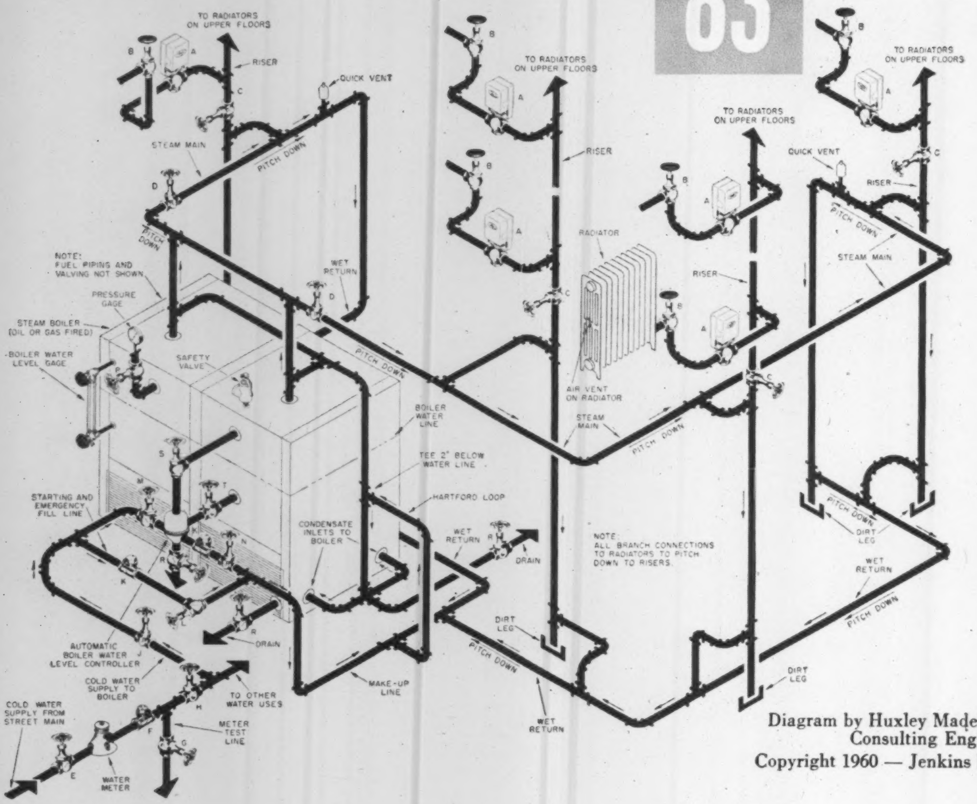
TO RADIATORS ON UPPER FLOORS
RISER
QUICK VENT
STEAM MAIN
PITCH DOWN
A
B
C
D
NOTE: FUEL PIPING AND VALVING NOT SHOWN
PRESSURE GAGE
STEAM BOILER (OIL OR GAS FIRED)
BOILER WATER LEVEL GAGE
P
SAFETY VALVE
WET RETURN
RADIATOR
AIR VENT ON RADIATOR
BOILER WATER LINE
TEE 2" BELOW WATER LINE
HARTFORD LOOP
STARTING AND EMERGENCY FILL LINE
S
M
T
K
N
R
L
J
CONDENSATE INLETS TO BOILER
DRAIN
AUTOMATIC BOILER WATER LEVEL CONTROLLER
COLD WATER SUPPLY TO BOILER
COLD WATER SUPPLY FROM STREET MAIN
TO OTHER WATER USES
H
F
G
E
METER TEST LINE
WATER METER
MAKE-UP LINE
DIRT LEG
NOTE: ALL BRANCH CONNECTIONS TO RADIATORS TO PITCH DOWN TO RISERS.

Diagram by Huxley Madeheim
Consulting Engineer
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ONE-PIPE HEATING SYSTEM WITH INDIVIDUAL THERMOSTATIC CONTROL OF EACH AREA

Because of low installation, operation and maintenance costs, this one-pipe system is popular for multi-story buildings where radiators are placed one above the other in line on various floors. It requires no traps, pumps, expansion or balance tanks or special fittings, and its simplicity avoids danger of freeze-up or water leaks. Thermostatic control of the fuel burner and elimination of dependence upon manually-controlled radiators remove principal objections to the conventional one-pipe system . . . the time delay in starting from a cold boiler, uneven heating due to this delay, and insufficient pressure to assure steam in furthermost radiators.

The burner in the boiler of this system operates responsive to an outdoor thermostat which starts or cuts off the burner whenever outside temperature changes from a predetermined value. The burner is also controlled by a pressurestat which cuts off burner at a predetermined value such as 8 psi, and starts it at a lower limit such as 4 psi. The burner can also be controlled by a program clock.

Each individual radiator or area is controlled by a motor operated globe valve of the type made by New England Gear Works, Southington, Connecticut. Each of the valves opens or closes responsive to a thermostat located in the area served by the radiator. The combination of outdoor and area thermostats assures steam in the system and even heat at all times in all areas. A manually-operated radiator angle valve permits shut-off of each radiator whenever desired. A gate valve at bottom of each riser allows access to motor operated valves on that line.

Conventional steam boiler piping and controls are used, with an automatic boiler water level controller, fitted with a manually operated by-pass.

Jenkins Fig. 47-U Standard Bronze Gate Valve, in this layout has design features which assure excellent performance in steam heating service. A solid bronze wedge affords maximum resistance to pressure strains of rapidly vibrating steam. A rising spindle and wheel indicates wedge position, and the backseating bevel on shoulder of spindle permits the valve to be repacked under pressure when wide open.

To assure efficiency in the job when planning any major piping installation, consult with accredited piping engineers and contractors, and select your valves from the Jenkins Catalog.

Enlarged diagram and full description of this layout No. 83 free on request to Jenkins Bros., 100 Park Avenue, New York 17.

CODE	QUAN.	VALVES RECOMMENDED	SERVICE
A	6	Motor Operated Globe made by New England Gear Works	Automatic Steam Control
B	6*	Fig. 168, Bronze Radiator Angle	Manual Control Steam to Radiators
C	4**	Fig. 47-U, Bronze Gate	Individual Riser Shutoff
D	2	Fig. 47-U, Bronze Gate	Boiler Mains Shutoff
E	1	Fig. 47-U, Bronze Gate	City Water Supply Shutoff
F	1	Fig. 92-A, Bronze Swing Check	Prevent Backflow into City Water Main
G	1	Fig. 106-A, Bronze Globe	Meter Test Flow Control
H	1	Fig. 47-U, Bronze Gate	Building from Meter Shutoff
J	1	Fig. 47-U, Bronze Gate	City Water Make-up to Boiler Shutoff
K	2	Fig. 92-A, Bronze Check	Prevent Backflow from Boiler to City Water
L	1	Fig. 108-A, Bronze Angle	Manual Control Water to Boiler
M	1	Fig. 106-A, Bronze Globe	Control Automatic Boiler Water Level Controller
N	1	Fig. 47-U, Bronze Gate	Shutoff Automatic Boiler Water Level Controller
P	1	Fig. 743-G, Bronze Needle	Steam to Pressure Gage Control
R	3	Fig. 108-A, Bronze Angle	Control Drainage from Boiler aad Equipment
S	1	Fig. 108-A, Bronze Angle	Shutoff Automatic Boiler Water Level Controller from Boiler
T	1	Fig. 106-A, Bronze Globe	Shutoff Automatic Boiler Water Level Controller from Boiler

*One for each Radiator **One for each Riser

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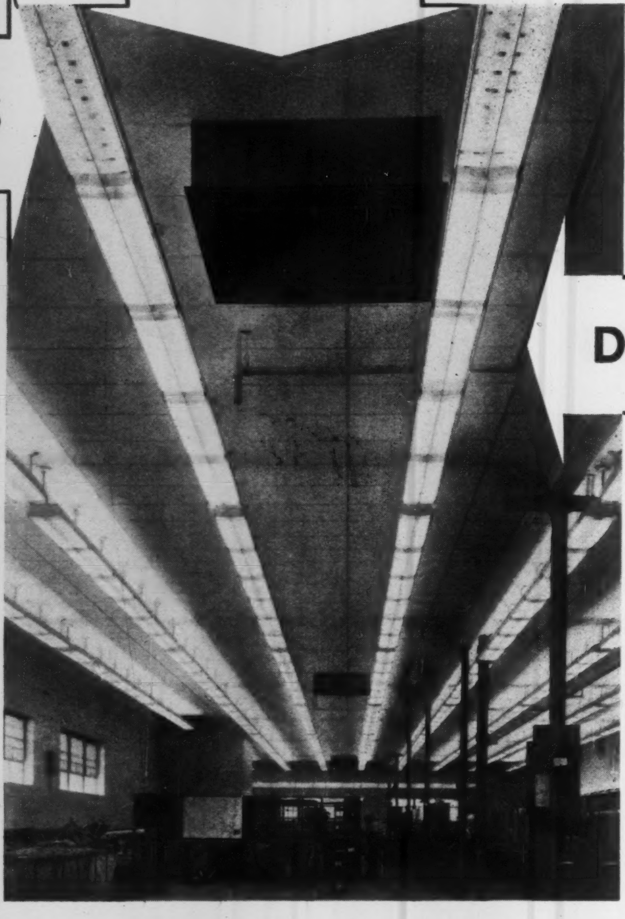

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Heating, Piping & Air Conditioning

FOR CONSULTING ENGINEERS, MECHANICAL (HEATING, PIPING, AND AIR CONDITIONING) CONTRACTORS, ENGINEERS WITH PLANTS AND BIG BUILDINGS

VOL. 32, NO. 10 OCTOBER 1960

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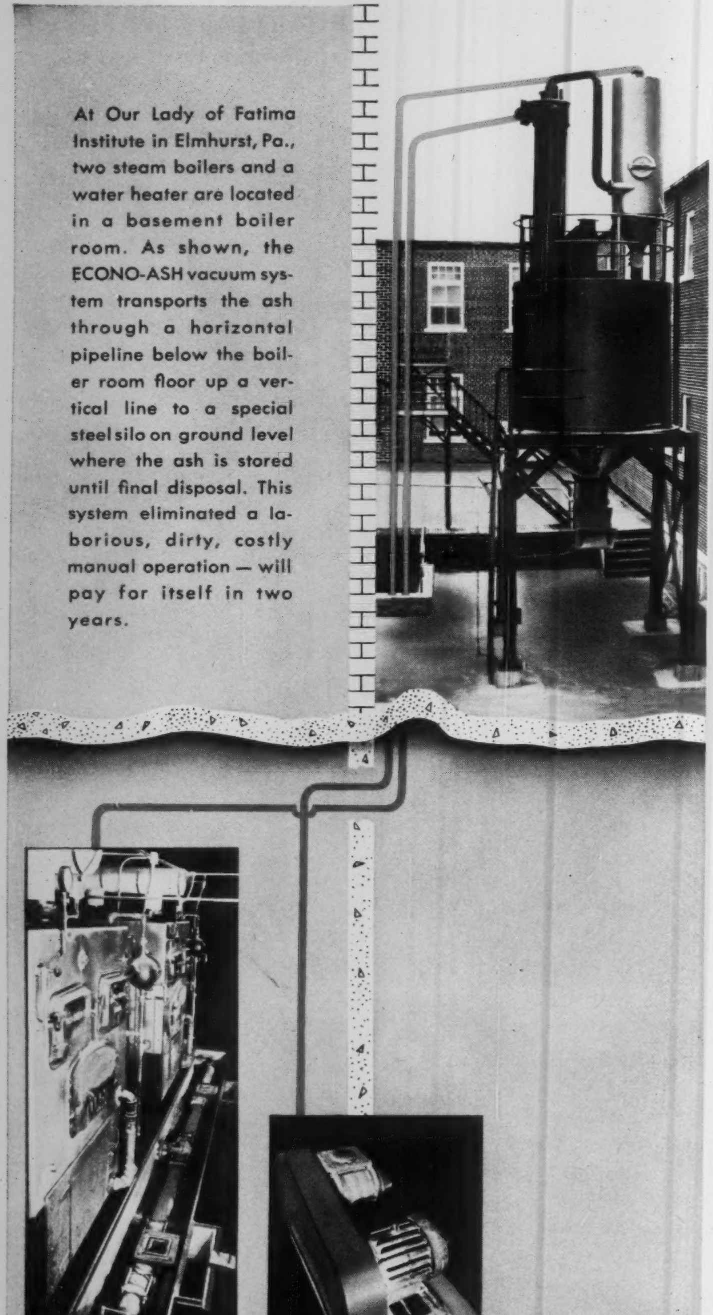

At Our Lady of Fatima Institute in Elmhurst, Pa., two steam boilers and a water heater are located in a basement boiler room. As shown, the ECONO-ASH vacuum system transports the ash through a horizontal pipeline below the boiler room floor up a vertical line to a special steel silo on ground level where the ash is stored until final disposal. This system eliminated a laborious, dirty, costly manual operation — will pay for itself in two years.

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Third, ash removal with the ECONO-ASH System is so much faster that you'll save significant amounts in labor costs. Normally, your Fireman will remove the ash during his regular tour of duty.

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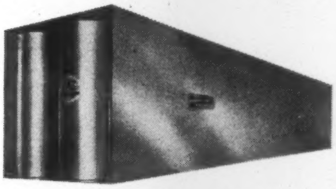

Available in 4 Standard Models —
23 Standard Unit Sizes —
2 Connection Types

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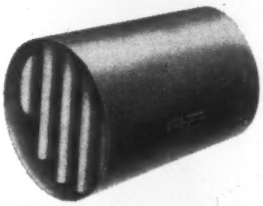

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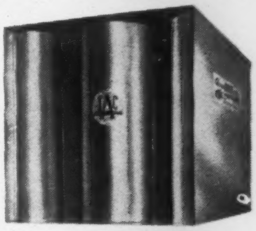

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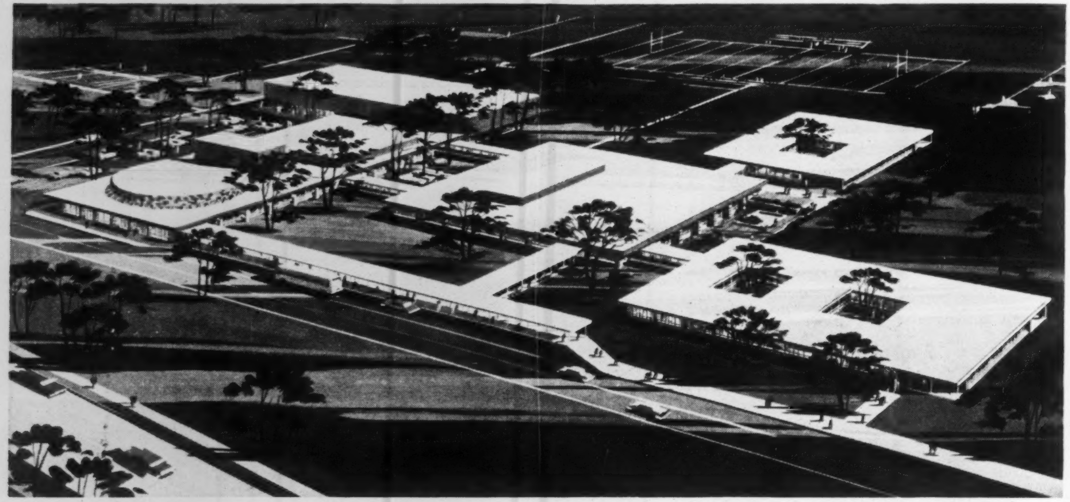
How Imaginative Engineering Provided Air Conditioning To Fit A School Budget

Must school air conditioning always be "too expensive"? Perkins & Will, Chicago architects and engineers, didn't think so last year when they designed suburban Homewood-Flossmoor High School. Without exceeding the school budget, they provided an air conditioned area large enough for complete summer sessions, including 15 classrooms, the library and all administrative offices. Actually, cooling for 25,000 square feet added less than 3½% to normal building cost — less than $4 per square foot of cooled area.

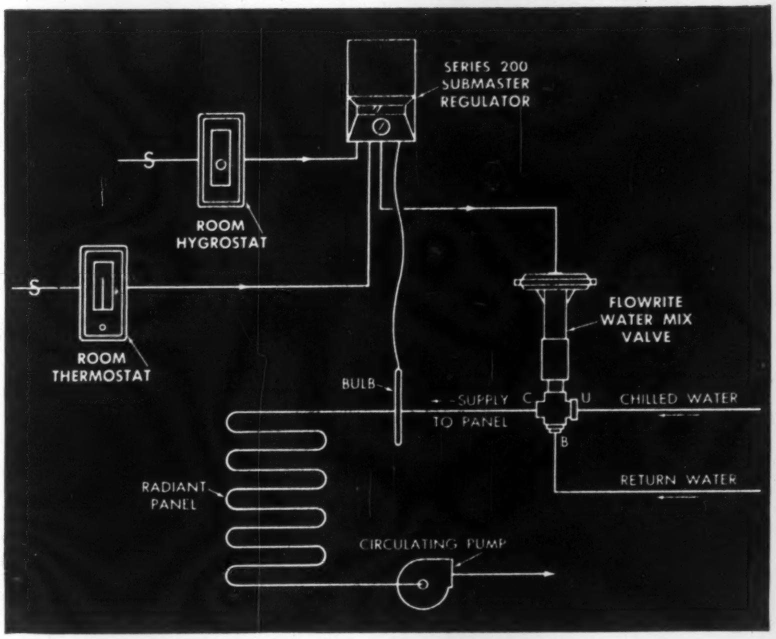


Homewood-Flossmoor High School, Flossmoor, Illinois. Air conditioned section (center) connects to other school facilities by glass-enclosed passageways.
Architects and Engineers: PERKINS & WILL, CHICAGO
Mechanical Contractor: THE ECONOMY PLUMBING AND HEATING CO. OF CHICAGO.

Perkins & Will team of architects and engineers works out details of the cooling system design features and controls for the Homewood-Flossmoor school. From left to right are F. Philip Brotherton, Designer and Project Architect; Rudolph J. Houkal, Chief Mechanical Engineer, and Edward C. Colin, Chief Structural Engineer.

How it was done

Perkins & Will grouped all rooms where both heating and cooling were desired into one section of the school. An interesting design feature is the core of 15 classrooms, surrounded on all sides by other rooms. The fuel savings realized from this "insulated" core help defray the added expense of cooling the entire summer school section. The engineers concentrated all mechanical service equipment beneath this section to eliminate long air conditioning channels. Double ducts and automatic controls were carefully designed for easy switchover to cooling and to take full advantage of tempered return air and outside air during spring and fall seasons.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S
ROOM
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ROOM
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FLOWRITE
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VALVE
BULB
SUPPLY
TO PANEL
C
U
B
CHILLED WATER
RETURN WATER
RADIANT
PANEL
CIRCULATING PUMP

Ceiling Panel Condensation Control

To back up the mechanical efficiency it so carefully designed into the heating, cooling and ventilating system, the Perkins & Will firm specified a Powers system of pneumatic temperature control, including the important dew point control which acts on the chilled water auxiliary cooling used in rooms exposed to the outside. This control (see diagram) utilizes a Powers Water Mix Valve on the ceiling panel chilled water supply and a low limit Submaster Regulator. The Powers Hygrostat measures room humidity conditions and resets the low limit temperature to prevent condensation on panel surfaces, yet allows supply water temperature to be as low as possible for maximum cooling.

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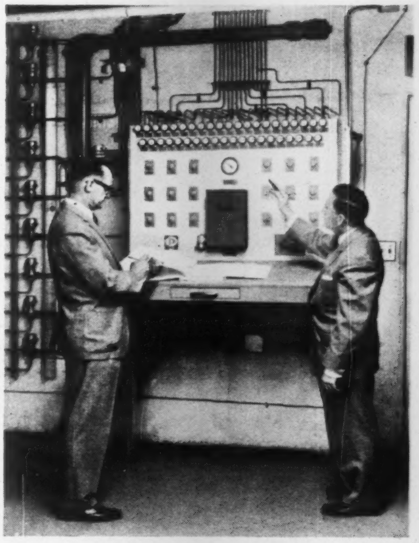

Homewood-Flossmoor Maintenance Superintendent William C. Drews (left), takes readings from the automatic Powers pneumatic control panel.

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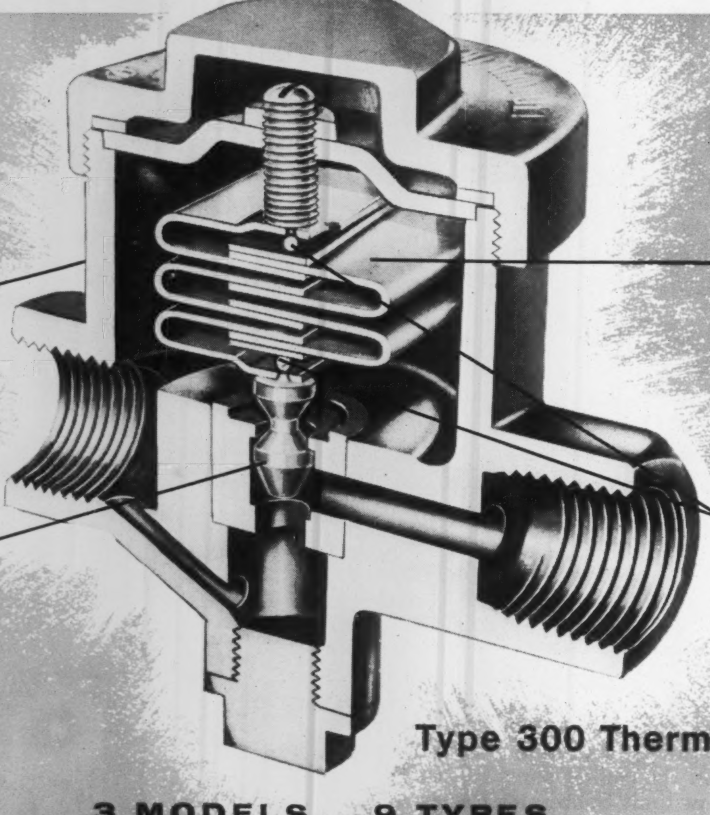

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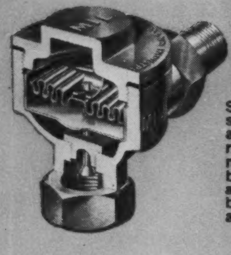

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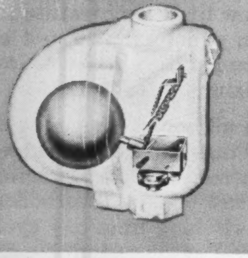
Self-Adjusting models are factory set to release water and air from a steam system as well as to release condensate at a predetermined temperature. Available in 4 body patterns in 25 psi, 65 psi and 125 psi ratings, forged bronze bodies, stainless steel element and valve, aluminum bronze seat.



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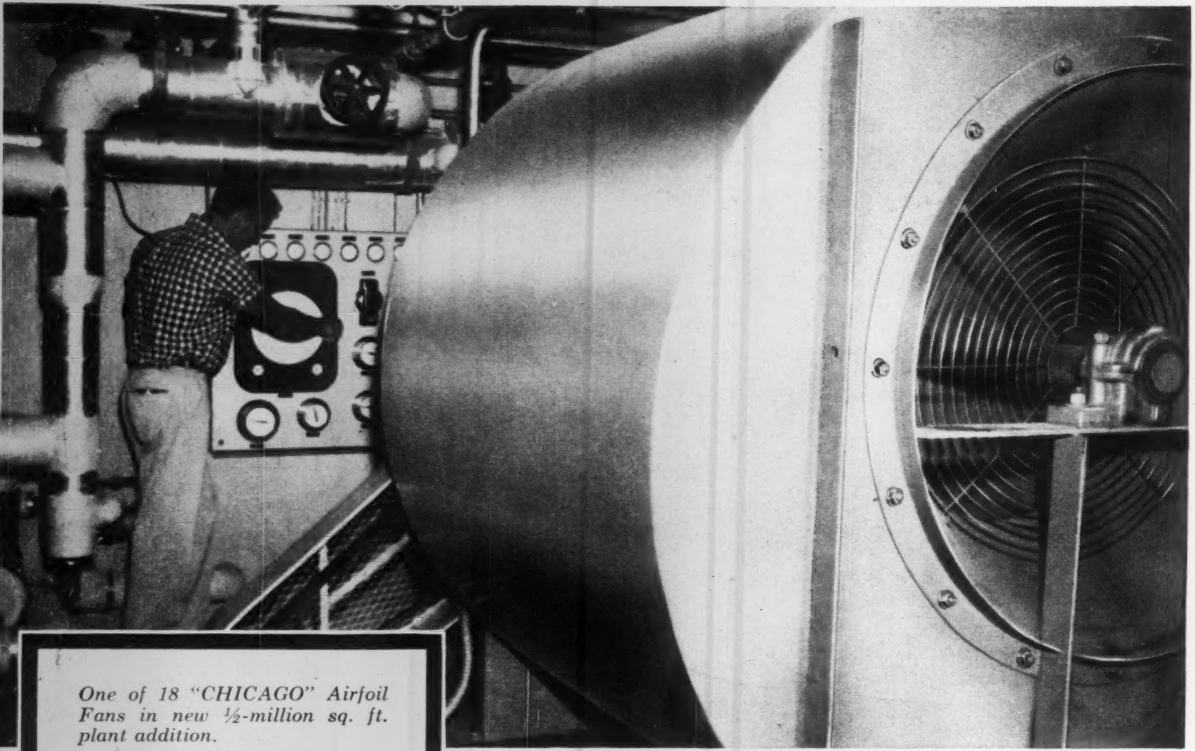

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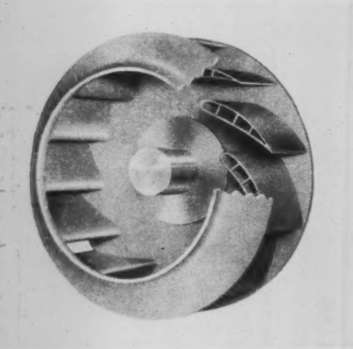

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0502

LETTER FROM THE EDITOR

October 1960

Dear Reader:

The problem of integrating old and new heating and air conditioning systems in old and new buildings is discussed by Stanley T. Kanno in his article on pages 109 through 112. His article explains how the systems in the home offices of The Ohio Oil Co. were converted to a central year 'round air conditioning system and how the central utilities plant is used to provide steam and hot water heating services to the entire six building complex and chilled water for cooling to the newest buildings. Future expansion was carefully planned into the design of these new facilities and the central plant, so the new buildings could be served with chilled water for air conditioning. The same cooling towers serve both the new system and central station units in the older buildings. In the future, these too will be converted to the one chilled water system.

One way to cope with the increased cooling loads imposed by the larger external glass areas and higher internal lighting levels is to use integrated lighting and air conditioning. Will Fisher and John Flynn explain the principles of such an integrated system in their article on pages 113 through 117. They point out what the modern lighting loads are and make some excellent suggestions as to how they should be handled. They also discuss the advantages of such an integrated system and what costs may be expected.

Good piping practices pay off in most cases, and in the article on pages 118 to 120, William Lesher shows how this applies in the lumber and plywood industry. The special requirements in the manufacture of these products impose rugged demands on steam, water, compressed air, and other piping services. Mr. Lesher explains how these systems have been designed for the wood products plants recently built for the Georgia Pacific Corp. in California and Oregon. He points out in this article several tips too on what has been done to assure good operation and maintenance of these piping systems.

Suspended radiant panels supplied by a hot water heating system designed for a 40 F temperature drop are two important elements that have made it possible to provide a space savings advantage in a new six-building junior high school in the Cincinnati area. R. Burgett explains what was done and why it was done on pages 121 through 123. The radiant panels and individual air handling units are supplied by the same central hot water source. With the larger than usual temperature drop, smaller distribution lines could be used which represented a saving in initial cost and in space as well.

A three-pipe system has been designed for a new medical-dental building in the Lansing, Michigan area that has proven to be highly successful, according to Anton Krapek, as explained in his article on pages 125 to 128. Fan-coil units are used in two ways. One of these is as year 'round air conditioners in exterior rooms, and the other is for air recirculation only in interior spaces. Individual room control is achieved for the many different offices through this three-pipe system. Separate hot and chilled water lines are connected to a thermostatically controlled three-way valve at each terminal unit, but a single common return is used from all coils. The return line is split, and one leg goes to a heat exchanger and one goes to an absorption-type chiller on the discharge side of the pump. Here's another case where the engineering design included provisions for proper servicing of valves and equipment to assure good operation and maintenance.

LETTER FROM THE EDITOR (Continued) --

Another report by John Collins of the National District Heating Association about their recent annual meeting is on pages 129 to 132. He tells in this article how city codes assist summer air conditioning steam sales, how high and low temperatures affect metals, and how obsolescent electric plants can produce steam for sale.

Designing air conditioning systems for modern offices equipped with computers and other data processing machines can lead to problems that may be difficult to solve. LeRoy Varner explains in his article on pages 133 and 134 how the Penn Mutual Life Insurance Co. has profited from the mistakes by others on similar installations by using return air for reheat through a multi-zone air handling unit. Through this system he reports that the cold, drafty conditions common to other systems which he has inspected are not present in this installation, and he says worker morale and efficiency are high.

The importance of ground water as a good cooling medium is growing for industrial uses, and John Hoffman discusses this subject in his article on pages 135 to 142. He explains what water temperatures may be expected at given depths, what the ground water reservoir is, and how it can be used. Well completion does not necessarily insure a successful installation. Important also are the temperature and chemistry of the ground water and the factors influencing the movement of ground water in the vicinity of a pumped well.

The data sheet article is on pages 143 and 144 and contains a nomograph showing how standard condition ratings for centrifugal fans and pumps can be corrected. F. Caplan is the author.

The need for providing makeup air to replace the air exhausted in the industrial plants of today cannot be overstressed. George Reznor explains what should be done on pages 146 to 148 including how to design a makeup air system, how to select the equipment, how to control the system to avoid discomfort of the occupants, and how to keep operating and maintenance costs down to a minimum.

Even though there are many ways that heating, piping, and air conditioning equipment can be maintained, it is agreed by most engineers today that a preventive maintenance program should be followed to assure dependable operation. Don Bahnfleth, HPAC Engineering Editor, has prepared the Engineering Data File on this subject for this issue which begins on page 149. He has included many suggestions as to what should be considered in this type of maintenance program in order for it to be effective. Some of these items are knowing the system and the equipment needs, how often should the equipment be inspected, determining the skills of the men available for performing maintenance, how to schedule the work for the best results, what type of records should be used, and how to train personnel for the maintenance function. Many sources of information were used in preparing this Data File, and it was our intent to present workable methods and ideas from all of those surveyed. However, we would like to have your comments on this subject because we know that there are many different methods and approaches that are being used with success.

Two answers are given on pages 100 and 104 to the question, "How Should We Size Relief Valves For HTHW Water-to-Steam Converters?" which will be of interest to you, I am sure.

You'll Want to Know is on pages 39 to 44 and contains many news items and other information of interest.

Bob Roose

Editor, HEATING, PIPING & AIR CONDITIONING

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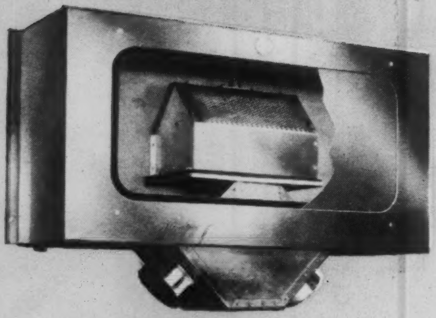

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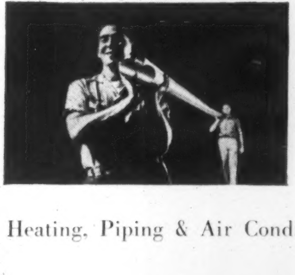

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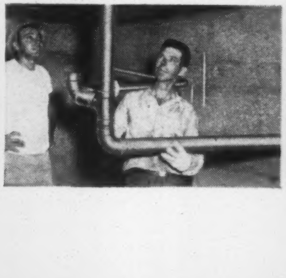

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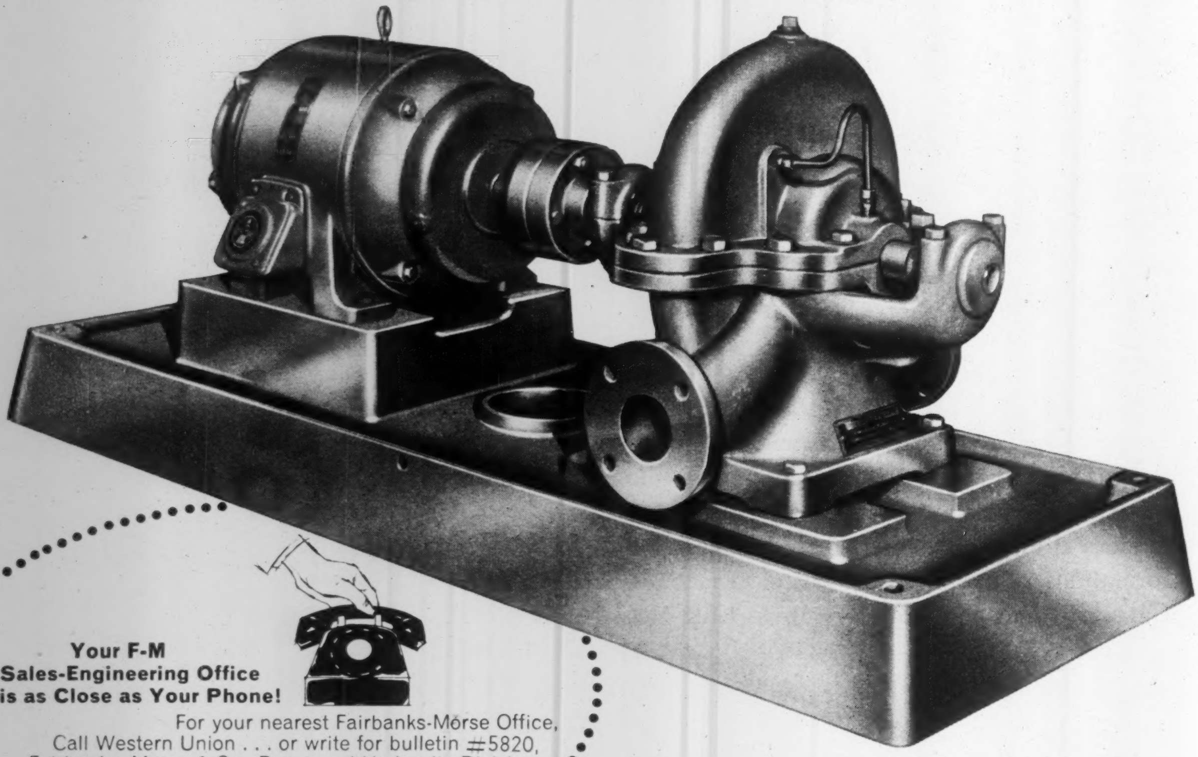

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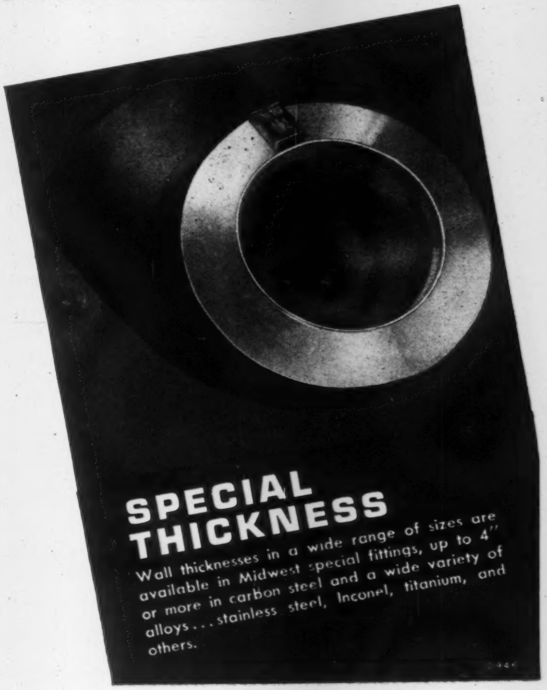

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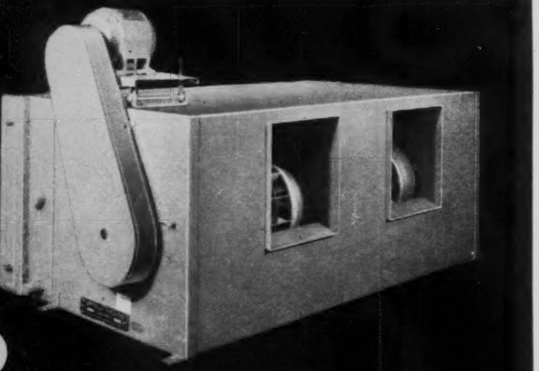

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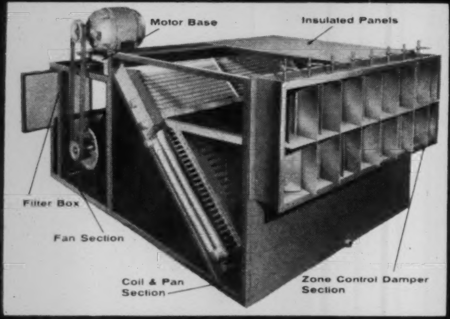

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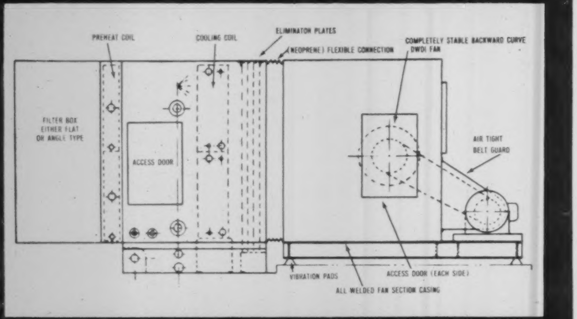

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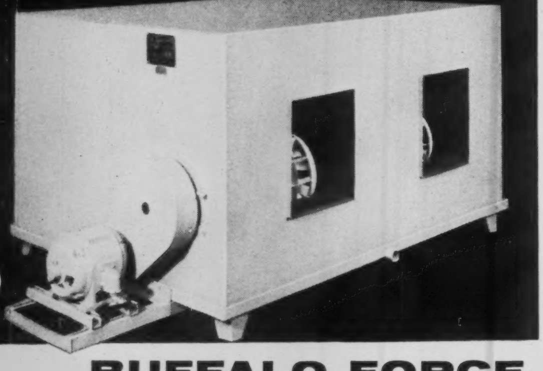

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Start with your simplest heating and ventilating requirements and proceed to the most complex conduit system. There's a 'Buffalo' Cabinet or combination of cabinets to deliver the exact air conditions called for in the plans. 'Buffalo' continues to develop new equipment to meet the most rigorous demands. You are assured of performance-as-specified whenever you write 'Buffalo' into the plans.

Check these quality 'Buffalo' engineering features:

- 'Buffalo' Fans with oversize hollow shafts for vibrationless operation. Backward curved blades for completely stable performance. Limit-Load horsepower characteristic for positive overload protection.
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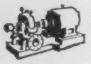

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

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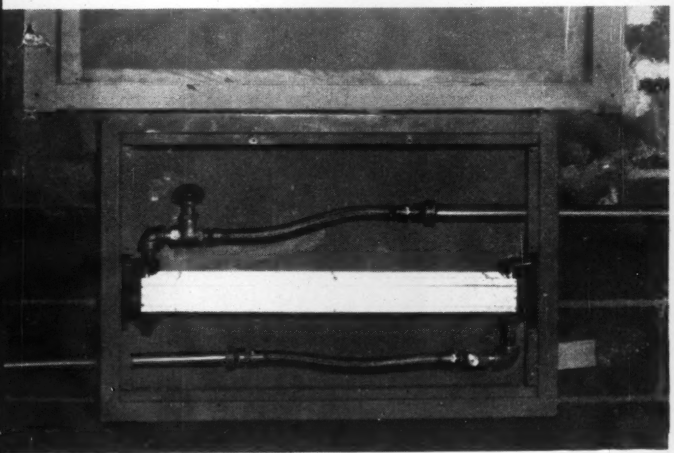
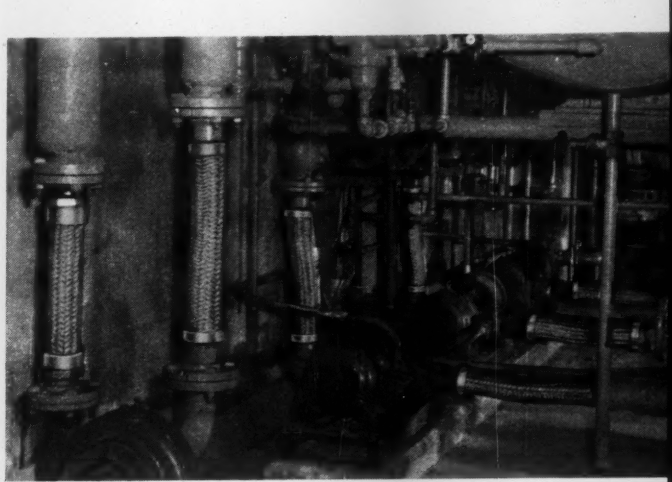
APPLICATION HINTS:

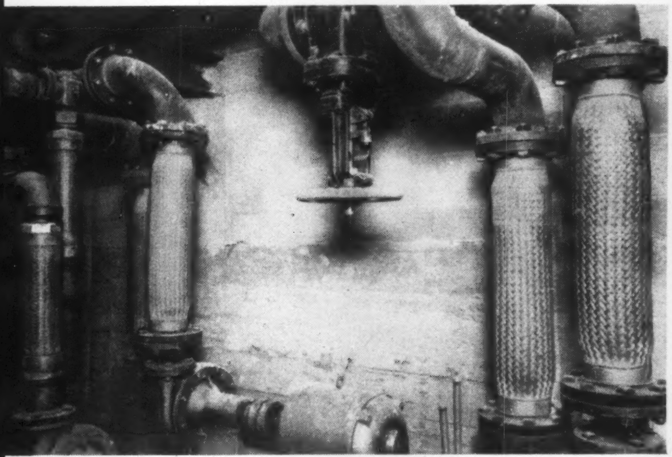
Ways to simplify construction and cut costs with Flexpipe



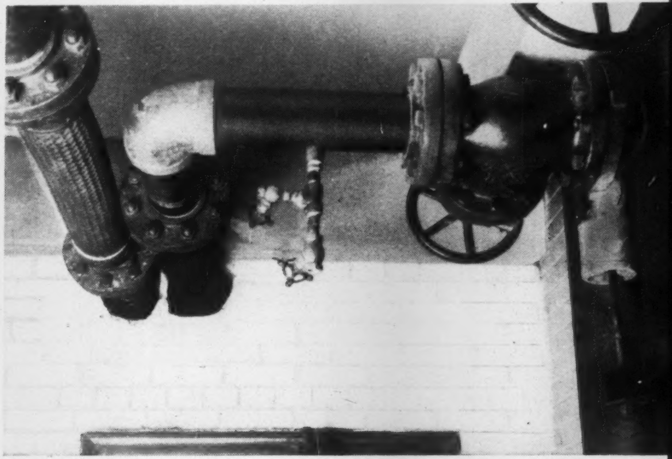
Cut total piping costs of heating systems. Flexpipe connectors handle offset and riser expansion—eliminate the need for extreme accuracy in roughing-in—eliminate time and cost of through-floor connections, hung ceilings and furred out walls. Piping can hug the wall, saving floor space. Flexpipes are used to simplify design and installation in both steam and hot water heating systems.



Save space, absorb vibration, cut installation time in air conditioning systems. In larger heating and cooling systems, Flexpipes take up movement caused by expansion and contraction in piping—absorb vibration from pumps—require less space—install easily in tight quarters—even when outlets do not line up—cut costs of using short lengths of pipe and elbows.



Handle expansion on long horizontal runs in big hot water jobs. Modern schools and institutions of multi-structure design involve long horizontal runs for hot water heating mains. Using Flexpipes to take up expansion and contraction in the mains can often eliminate the need for expansion bends—make possible smaller, more economical tunnels—simplify and speed installation—reduce maintenance. Flexpipes also dampen pump vibration and minimize transmission of noise along the heating mains.



Meet big, tough piping problems. Flexpipes have the flexibility and strength to handle many unusual and complex jobs. These are available in sizes through 16" I.D. in tin bronze, stainless steel or hot-dipped galvanized steel. In the installation above, Flexpipes helped solve some difficult problems in air conditioning a large office building. Flexpipes connect risers and branch pipes, handle movement up to 2 inches in the spring-mounted risers, and water pressures up to 400 psi at lower floors.

WHERE TO BUY: Leading plumbing and heating supply houses can provide you with information about Flexpipe in standard sizes. For the name and address of the distributor serving your area, or for more detailed information, write to: Anaconda Metal Hose, P.O. Box 791, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

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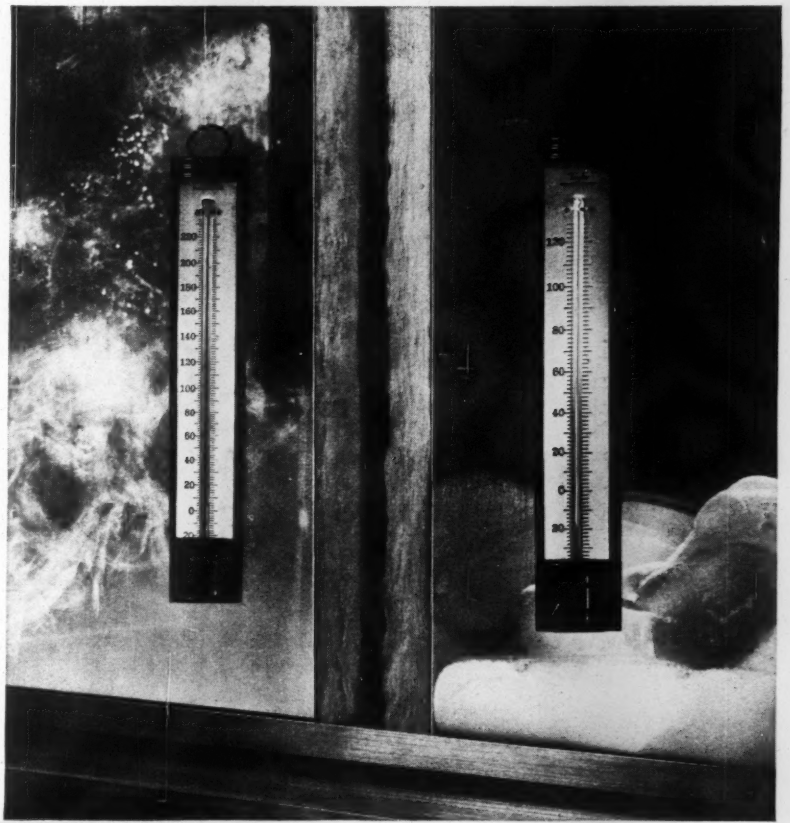
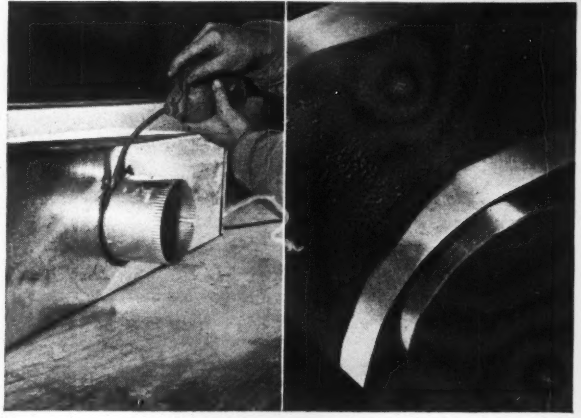


Even in temperature extremes . . . Insulation Adhesive 1128 HOLDS. Heat as high as 250° F. and temperatures as low as −20° F. can't weaken the bond. It holds fibrous glass insulation firmly on metal ducts and buildings. Highly resistant to moisture, 1128 also helps keep insulation dry when used to bond foil to foil where insulation facings lap.

Insulation Adhesive 1128 can be brushed or sprayed to provide both instant grip and long open time needed for positioning the insulation.



Even in high velocity systems . . . Duct Sealer 800 HOLDS. This sealer is so tough and flexible that a dry film ⅛″ thick will withstand bending over a six-inch mandrel at −65° F. Resistant to vibration, it flexes with duct expansion and contraction, won't flow out of seams under pressure even at 180° F. Furthermore, the airtight seal resists water, oil and ageing. Duct Sealer 800 goes on with brush, flow gun or putty knife and sets up so firmly at joints that duct work actually *gains* structural strength.

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. . . WHERE RESEARCH IS THE KEY TO TOMORROW

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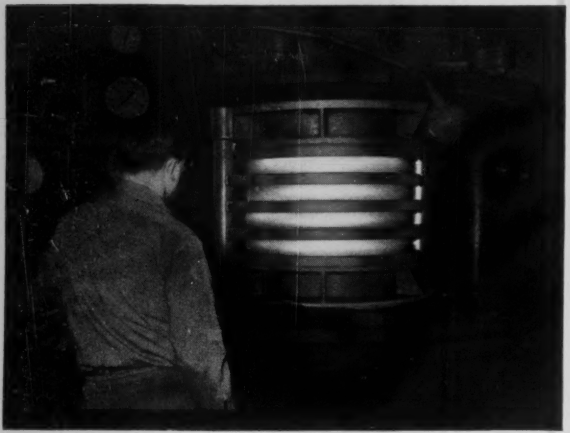
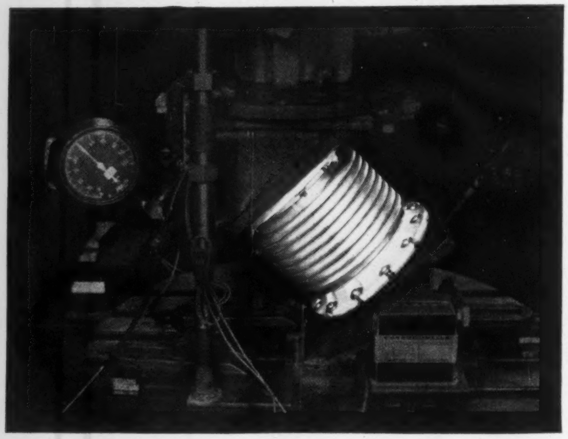
4 WAYS to get maximum reliability in expansion joints



1 Insist that the corrugated bellows be hydraulically formed. The reason is simple. Whenever bellows are formed by circumferential welding . . . whether by edge, seam or fillet welding . . . they will always be subject to premature failure because of stress concentrations at the welds.



2 Be sure the manufacturer maintains a continuous and comprehensive program of endurance testing. This is basic, because of the many variables that affect expansion joint life. Accurate determination of expansion joint life expectancy can only be determined by cycling to destruction.

3 Demand proof that the manufacturer can produce longitudinal welds in the corrugated bellows having the same strength, physical properties and thickness as the parent metal . . . without grinding. A weld that is hard to find is a ground weld. Variations in weld thickness set up points of stress concentration . . . opening the way for premature failure.

4 Check the ability of the manufacturer to supply a team of *competent* design and application specialists to work with your engineers. Check their specific experience in handling critical, complex applications in your field . . . complete to the record of successes or failures behind them, and details of how this experience will be brought to bear on your problem.

At Zallea, none of the many factors affecting expansion joint reliability are left to guesswork . . . including the four vital ones above.

This is reflected in these facts. Zallea material specifications are the most exacting in the industry. Zallea expansion joints are hydraulically formed. Zallea advanced welding techniques insure welds having the same thickness, strength and physical properties as the parent metal. Zallea has done more cyclic testing to destruction than all government agencies and industrial firms combined. Zallea has produced more expansion joints than any other manufacturer . . . offers more application engineering experience.

For all the facts, write for Catalog 56. Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.

Zallea for maximum reliability

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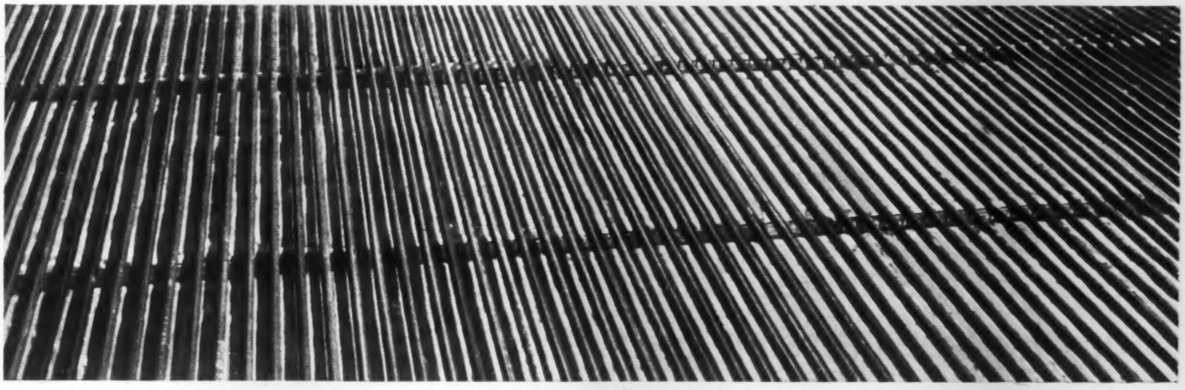
New rink in Tonawanda



built with Ammonoduct Steel Pipe

It's the new 85 by 185 ft Brighton Park Arena, Town of Tonawanda, N. Y., built by *Mollenberg-Betz Machine Company, Inc.* Park and Recreation Consultants: *Tryon & Schwartz & Associates.* Consulting Engineer: *William E. Harries.* The 58 tons of Bethlehem 1¼-in. standard black plain end Ammonoduct steel refrigeration pipe was supplied through *Commercial Pipe and Supply Company.*

Steel

for Strength
. . . Economy
. . . Versatility

Piping a new ice rink with steel is an easy way to please everyone. Owners find it economical—steel pipe costs considerably less than any other ferrous piping material. Contractors save on installation costs—in double-random lengths, Ammonoduct steel pipe eliminates many field welds; and it can be fabricated *cold* without fracture. Well-designed rinks piped in steel give long, trouble-free service—a boon to rink management.

Make your next rink a pleasure all around—underline it with Ammonoduct steel pipe. Your pipe distributor can give you the complete story. Or call the Bethlehem sales office nearest you.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

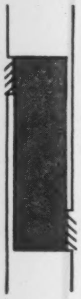
IMPORTANT ANNOUNCEMENT

to people who hear voices*

*voices that intrude or disrupt and noises that project when they should be hushed.

The new Aircoustat® Model W Return Air-Vent Silencers stop the transmission of noise without blocking air flow

Aircoustat Return Air-Vent Silencers eliminate the distracting sound of voices that spill from one area to another. Their slim design gives you a choice of installation. You can install them within a wall or ceiling or hang them on doors or walls. Let Koppers long experience in sound control help you. Write today for information to: KOPPERS COMPANY, INC., 3310 Scott Street, Baltimore 3, Maryland.



Model W Return Air-Vent Silencer

In sizes for all applications:

Model	Thickness	Width	Length
W-1	3½″	30″	48″
W-2	3½″	42″	48″
W-3	5″	30″	48″
W-4	5″	42″	48″
W-5	7″	30″	48″
W-6	7″	42″	48″

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SOUND CONTROL
METAL PRODUCTS DIVISION
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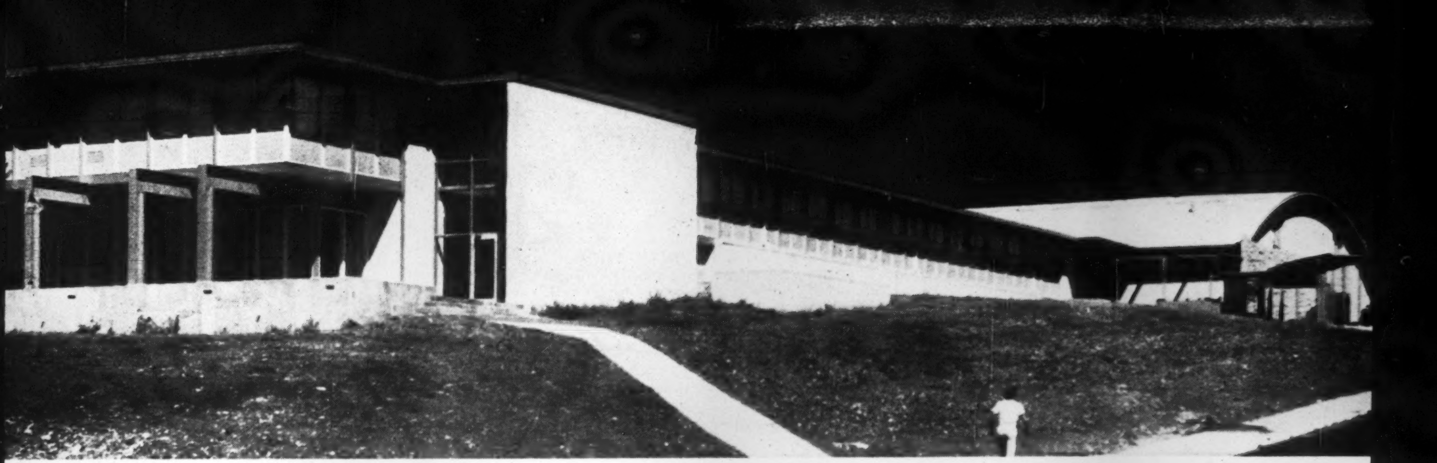
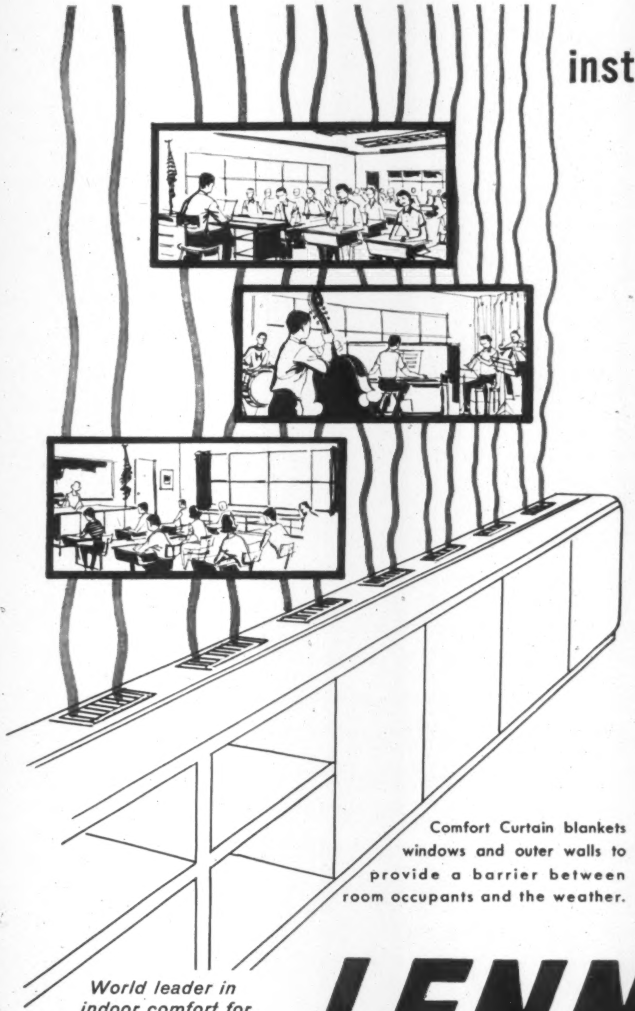


Pleasant Hill High School
Pleasant Hill, Missouri
Matthews and Hillman, Architects & Engineers

LENNOX COMFORT CURTAIN provides instant response to constantly changing heat gains in this Missouri School



Comfort Curtain blankets windows and outer walls to provide a barrier between room occupants and the weather.

The curriculum of this high school requires teachers and students to move from room to room several times during the day . . . resulting in constantly changing heat gains. Teachers, as a result, like the individual room controls because they can instantly adapt the temperature level to the number of students in the classroom; the activity in which the students are engaged; and outside weather conditions. The Comfort Curtain System in this 12-classroom school provides an air processing unit in each classroom which controls, blends and filters warm, return and fresh air. The conditioned air is distributed continuously across the full length of the exterior wall through functional, pre-finished metal bookshelf sections or wall ducts to eliminate cold spots, drafts and tired air. In this installation, gas fired heating sources, in approved construction heater rooms, are located on exterior walls between each two classrooms. Servicing of the entire system is handled by the local heating contractor.

WRITE TODAY FOR COMPLETE INFORMATION

For complete information about the Comfort Curtain System and its adaptability to in-the-room, two-room remote, central warm air, steam or hot water, heat pump, or electric heat sources, write LENNOX, 507 S. 12th Avenue, Marshalltown, Iowa, or phone your nearest Lennox office, listed below, and ask a technical representative to call.

World leader in indoor comfort for homes, business, schools and industry

LENNOX®

Comfort Curtain

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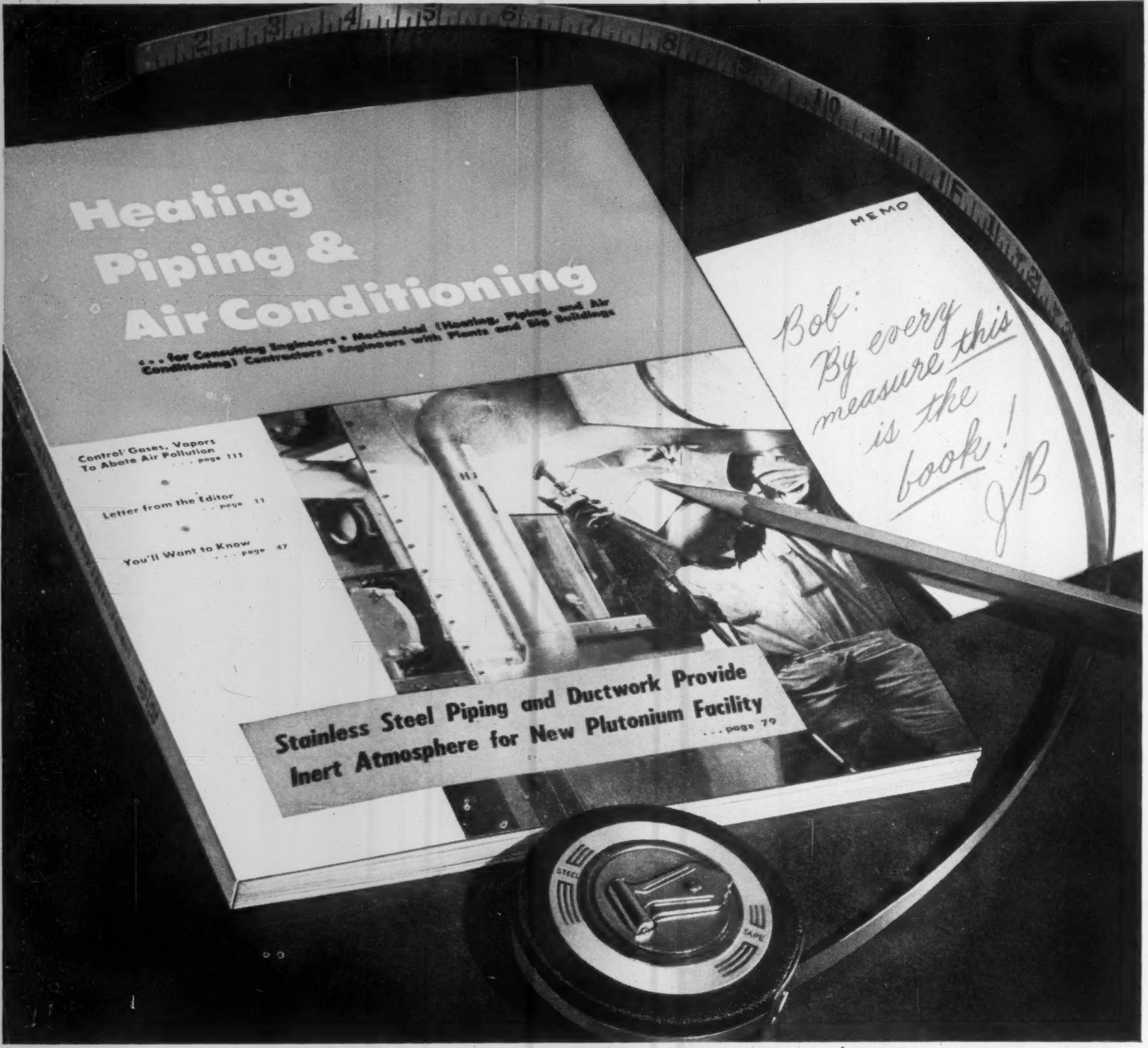
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Bob: By every measure this is the book! JB
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Faithful to its name, HEATING, PIPING & AIR CONDITIONING confines itself to these three services as related to just the industrial-large building field.

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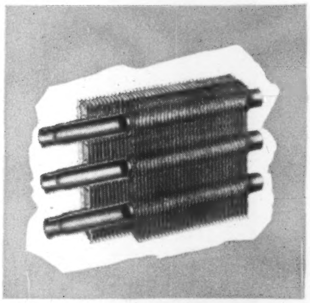

Seamless copper tubes are mechanically expanded into rippled aluminum fins formed with full width collars for accurate fin spacing to offer maximum heat transfer.

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UNIT HEATERS HAVE

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You get **extra** performance, **extra** efficiency from McQuay Unit Heaters equipped with the exclusive McQuay Ripple-Fin coils. And, McQuay Unit Heaters deliver heat quickly, uniformly and quietly. Ripple-Fin coils, combined with modern design and highest quality construction, offer you downflow, horizontal or cabinet type heaters that help you solve any low cost heating problem better . . . anywhere.

An exceptionally wide range of sizes and capacities is available for either steam or hot water. And, remember, you get bonus performance and efficiency only in McQuay Unit Heaters with McQuay Ripple-Fin coils! Ask your McQuay representative for complete information, or write McQuay, Inc., 1601 Broadway Street N.E., Minneapolis 13, Minnesota.

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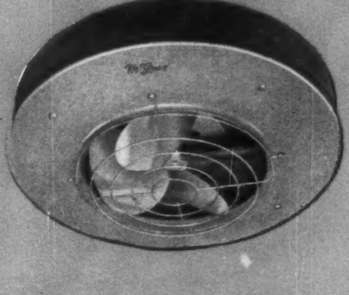
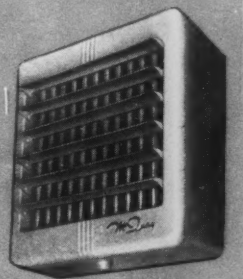


DOWNFLOW Unit Heaters. 32 sizes. Capacities from 25,000 to 610,000 Btu/hr. for steam. Five types of air deflectors are available for each unit.



HORIZONTAL Unit Heaters. 24 sizes. Capacities from 20,300 to 360,000 Btu/hr. for steam. Adjustable louvers standard equipment. Double deflection grilles available on special order.

CABINET Unit Heaters. 5 sizes—each with 3-speed control. Capacities from 23,600 to 108,000 Btu/hr. for steam. Designed for fully exposed, semi-recessed or fully recessed mounting on either floor, wall or ceiling.

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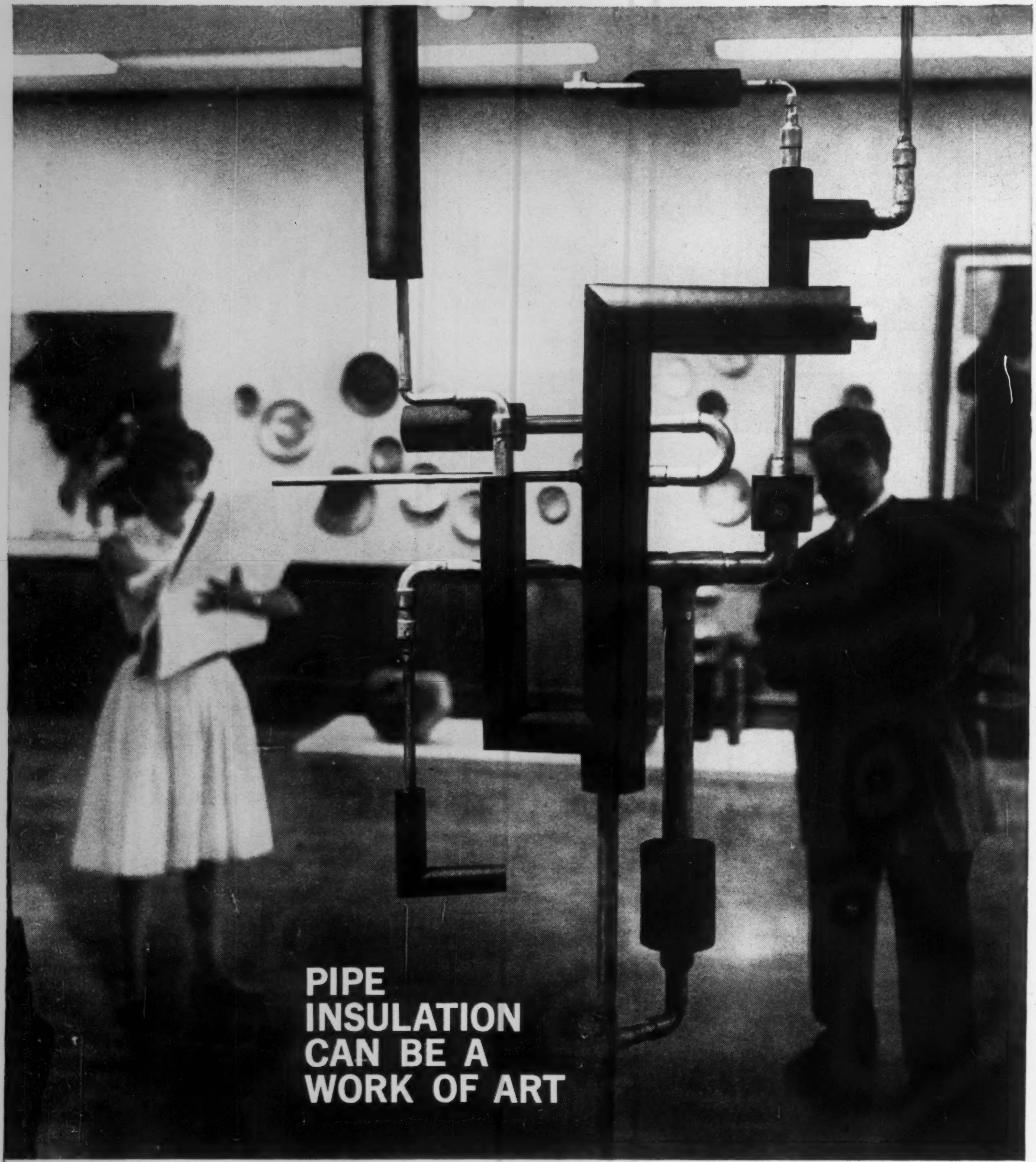

The job looks neater . . . goes faster with B. F. Goodrich insulation tubing

B.F.Goodrich insulation tubing makes the finished job look good enough to go on exhibition . . . *yet it takes 50% less time than the old-fashioned methods of insulating pipe.* It slips on straight or bent pipe as easily as a ring on your finger. If pipes are already connected, it can be slit, snapped on and cemented in no time. Fitting corners is no problem—you just slice off needed shape with a sharp knife and cement parts together.

This BFG tubing is made of tough, flexible cellular rubber that effectively insulates pipes carrying liquids ranging from −20°F. to 200°F. It doesn't rub off or crumble, comes in 6-foot lengths, many wall thicknesses. For full information, call your B.F.Goodrich distributor, or contact *The B.F.Goodrich Company, 181 Derby Place, Shelton, Connecticut.*

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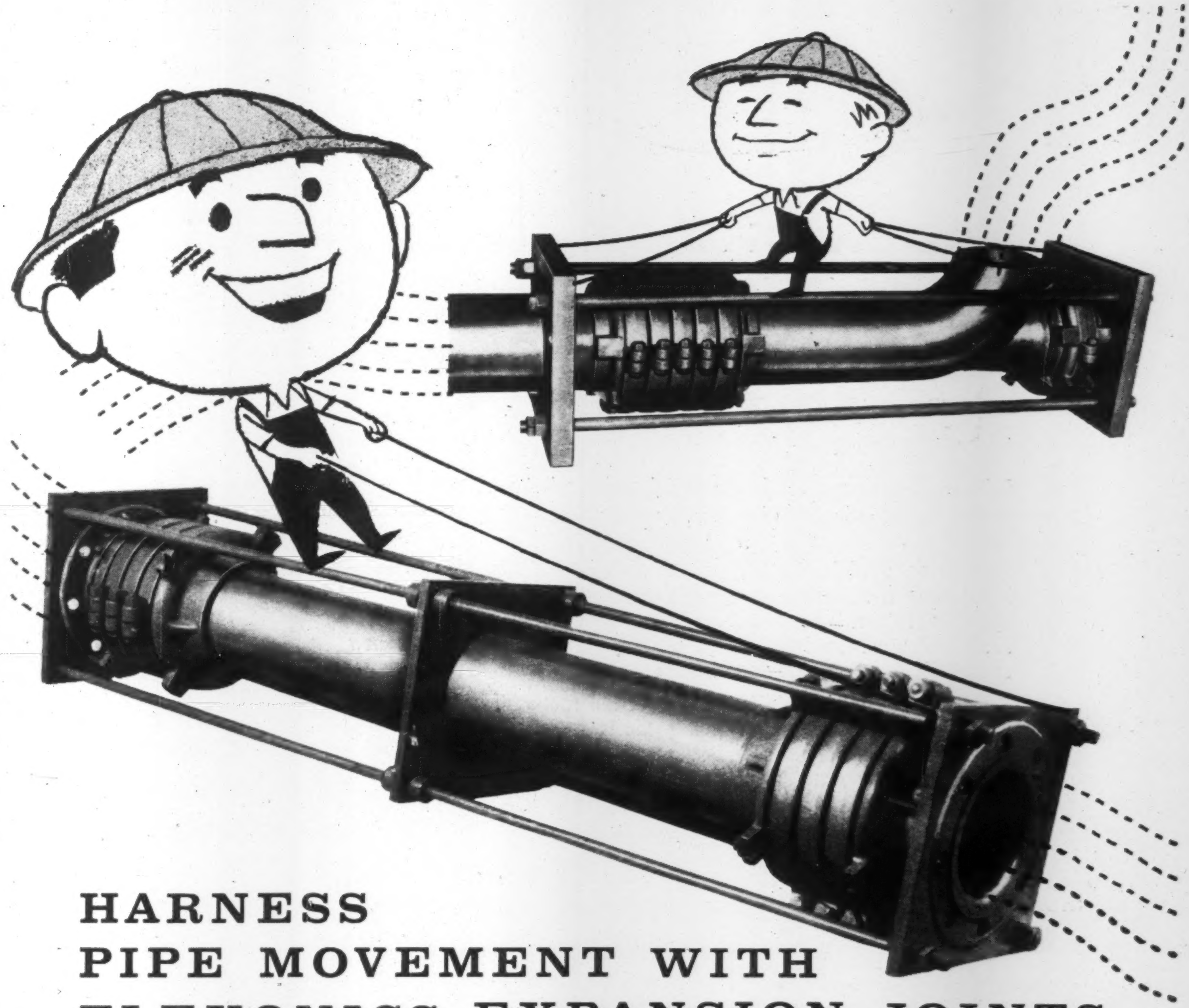

HARNESS PIPE MOVEMENT WITH FLEXONICS EXPANSION JOINTS

Here's how to keep pipe movement under control! **Flexonics Self-Restrained Dual Expansion Joints** can absorb large amounts of lateral movement while keeping anchor forces at a minimum. **Flexonics Pressure Balanced Expansion Joints** replace main anchoring at changes in piping direction, by restraining the end thrust.

These are just two of the standard and special types of expansion joints engineered and built by Flexonics to help you harness pipe movement. **Check and mail the coupon today for complete information.**

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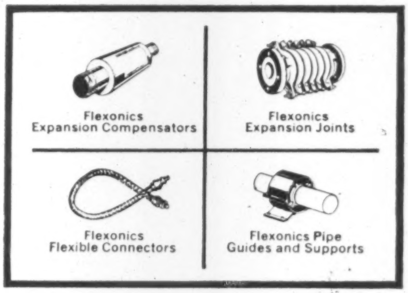

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Flexonics Expansion Joints
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Flexonics Pipe Guides and Supports

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Please rush me complete information on

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- ☐ Pipe Guides and Supports

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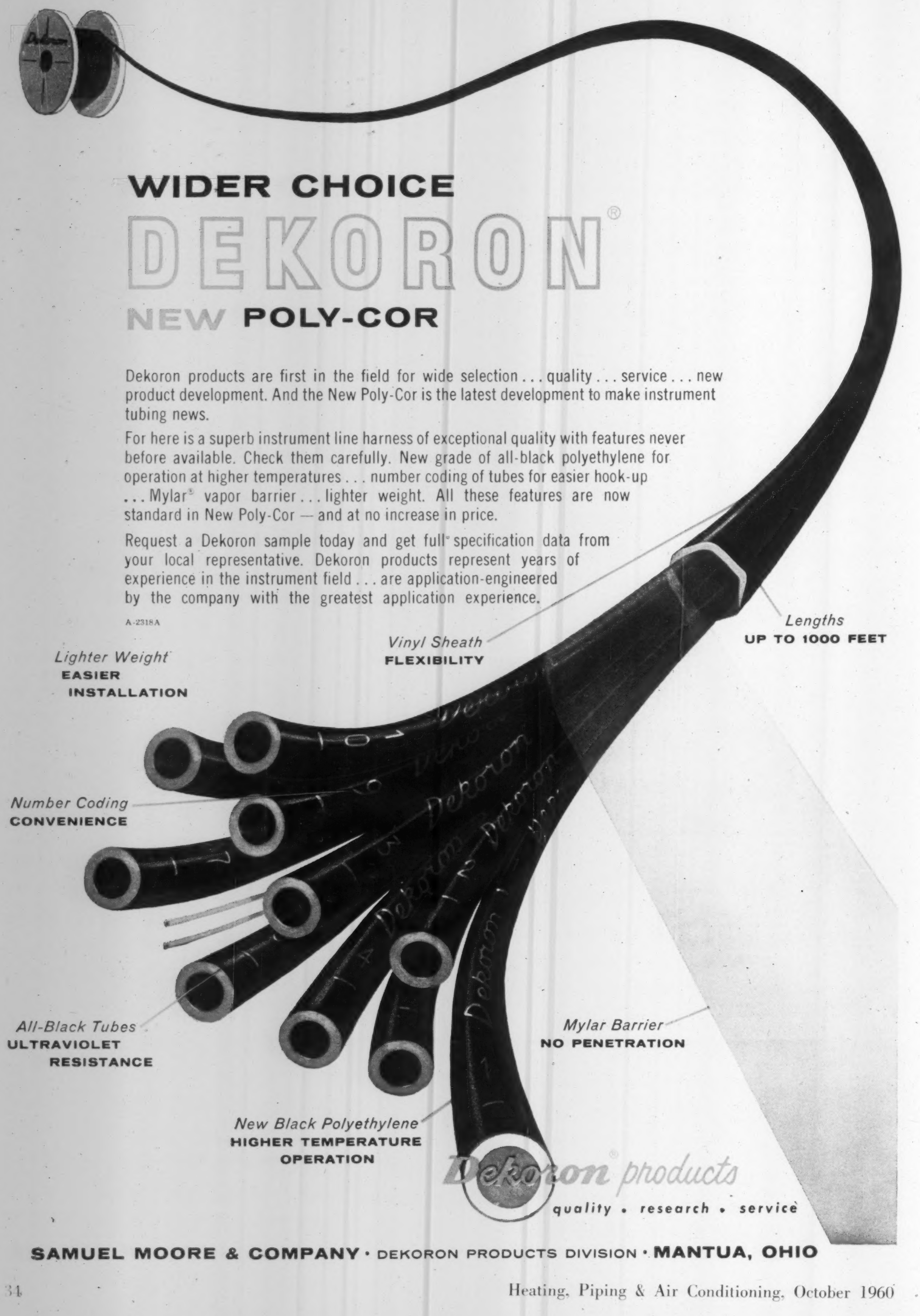
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Quiet...

WAGNER Polyphase Resilient Mounted Motors in ratings through 10 horsepower

Quiet, vibration-free performance is essential when motors are installed in areas where noise must be held to a minimum . . . in hospitals, churches, schools, office buildings, restaurants and similar locations where quiet is needed or wanted.

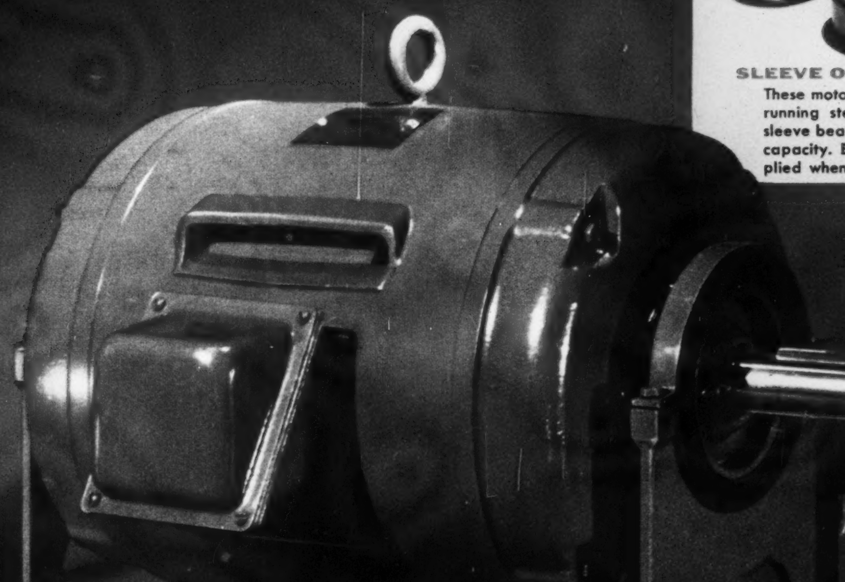
Such installations have created a need for larger polyphase motors that whisper while they work. Wagner has met this need by expanding its line of polyphase resilient mounted motors to include standard ratings through 10 hp.

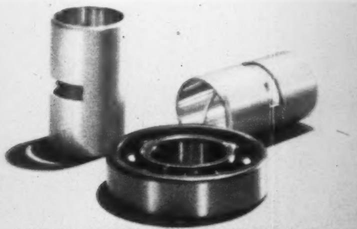
You certainly have applications that call for a smooth running motor, cushioned by resilient mountings. To make sure they're quiet, specify Wagner Polyphase Resilient Mounted Motors. Only Wagner can provide an entire range of ratings through 10 hp.

Constant research and development have kept Wagner up front in electric motor design for more than 65 years . . . made the name Wagner one you can depend on in choosing electric motor drives.

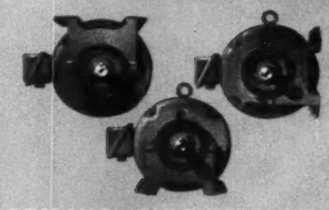
Your nearby Wagner Sales Engineer can help you select the right motor to meet your requirements. There are Wagner branch offices in 32 principal cities.

Wagner Electric Corporation
6400 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

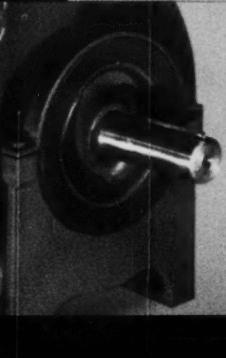




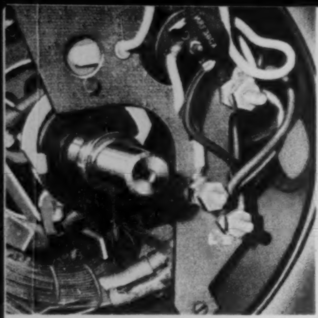
SLEEVE OR BALL BEARING. These motors are furnished with quiet running steel-backed babbitt-lined sleeve bearings of high load carrying capacity. Ball bearings can be supplied when desired.



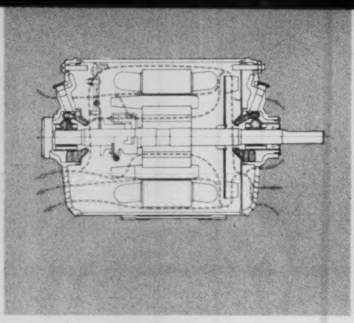
CEILING, SIDEWALL OR HORIZONTAL MOUNTING. You can mount these motors on walls or ceilings by rotating the cradle base 90° or 180°. Motor stays dripproof.



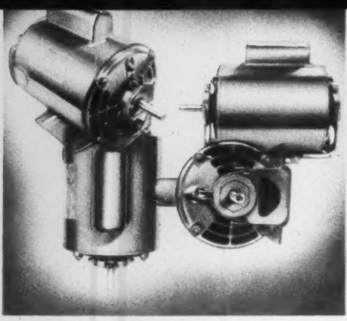
NEOPRENE CUSHIONING RING. Annular mountings, of oil-resistant neoprene bonded to steel rings, cushion the motor in its cradle base to absorb the small amount of vibration that remains in the most carefully balanced motor.



Quick Break Switch. The starting winding is disconnected from the line by this Wagner designed switch . . . test proved to make more than a million breaks. (That adds up to two starts per hour for 50 years!)



Efficient Cooling System. The improved ventilating system used in these motors directs a large volume of air through the motor to effectively reduce temperatures and add to motor life. Cross section indicates direction of air flow.



All-Angle Operation. The sleeve bearing design, in fractional hp ratings, has a positive lubrication system that permits operation in any position . . . can mean important savings in motor costs to manufacturers.

Quick Connect Terminals. Brass tabs on terminal studs permit quick, easy connection of leads . . . cut wiring time to speed assembly line production. Simply press the lead receptacle on to the stud—a positive connection is assured.

NO STARTING PROBLEMS with WAGNER CAPACITOR-START MOTORS

Pack more power into less space...give long troublefree service...are easy to hook up

Here are general purpose single-phase motors that have high starting torque and high pull-in torque. When used in the proper application and supplied with voltage close to their rating, they'll give positive starts every time. Troublefree operation is assured . . . thanks to the positive action of the Wagner governor mechanism and long life quick-break switch.

Wagner Type RK Motors pack more power into less space. Small enough to fit in tight spots, their ruggedness is built-in . . . permits direct mounting. And, sleeve bearing fhp models can be operated in any position. They are available in a range from 1/6 through 5 horsepower, with sleeve or ball bearings, and with rigid bases or resilient mountings.

Get these motors from leading motor distributors in your city, or from Wagner sales offices in 32 cities across the country. Your Wagner Sales Engineer will be glad to help you select the right motor for your application. Wagner Bulletin MU-217 gives full details on Capacitor-Start Motors.

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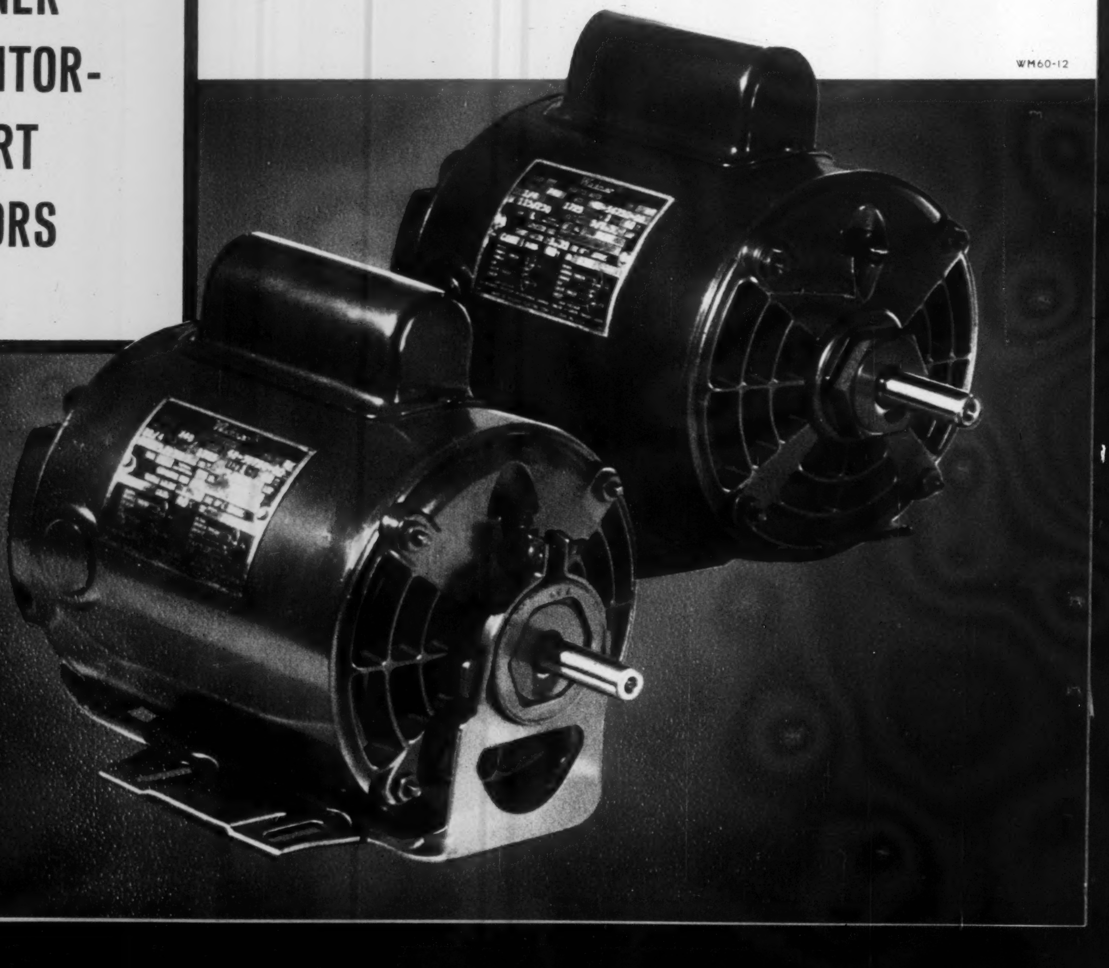
WM60-12



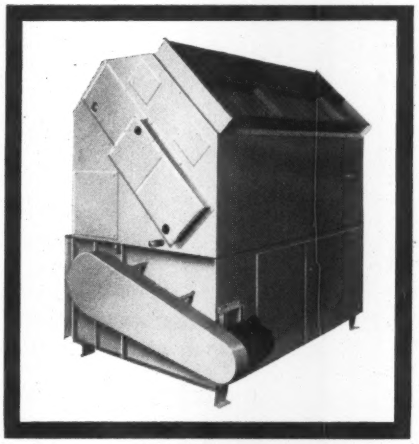
LINDSEY HOPKINS VOCATIONAL

ARCHITECT: Curtis E. Haley, Coral Gables, Fla.

CONSULTING ENGINEERS: J. E. Curley & Associates, Coral Gables, Fla.

THERMAL AGENT: A. C. Dean Co., Miami, Fla.

COMFORT AID TO EDUCATION



Vertical Multizone Unit

Thermal Units Air-Condition Huge Vocational School

The Lindsey Hopkins Vocational School in Miami, Florida, is believed to be the nation's largest and most successful adult vocational school with an enrollment of about 39,000. The building pictured above houses most of the classes which meet during the daytime and evening. Fifteen of Thermal Engineering's horizontal central plant type and multizone air conditioners maintain the comfort level in these busy classrooms.

From Presque Isle, Maine to Miami, Florida, and across the nation to the Pacific, Thermal Engineering's equipment is meeting the demand for year 'round comfort in all types of structures, under many varying climatic conditions. Its performance and quality assure architects and engineers that this equipment can be specified with confidence.

For finer air conditioning and ventilating equipment for every climate to fit all architectural requirements, you can specify Thermal. The Thermal line includes central plant and multizone conditioners, sprayed coil units, heating and ventilating units, heating and cooling coils and air-cooled condensers. We will be glad to furnish you our complete catalog.

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AGENTS IN PRINCIPAL CITIES

REMEMBER . . .

. . . the bite of the ice pick splitting a block of ice . . . the clank of tongs . . . the heave of the ice cake to the iceman's soaking shoulder apron? Remember his dripping trail up the walk, across the porch and kitchen to the icebox? What an appetite it had for cakes of ice . . . remember? And "mop up those tracks . . . don't forget to empty the drip pan!"

While the iceman made his rounds years ago, scientists worked to perfect a safe refrigerant. In 1931 development of "Freon" refrigerant opened the door to progress that has put safe, efficient, carefree refrigeration into nearly every home in the country. Today, "Freon" stands first for quality and leadership in serving the refrigeration and air conditioning industries.

Just as "Freon" is the refrigerant you know and trust, you can be sure Du Pont will continue research and development of its products and packaging. Always look for new developments from Du Pont. E. I. du Pont de Nemours & Co. (Inc.), "Freon" Products Division, Wilmington 98, Delaware.

*Freon and combinations of Freon- or F- followed by numerals are Du Pont's registered trademarks for its fluorinated hydrocarbon refrigerants.

Capped in gold
and factory-sealed
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refrigerants

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BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

you'll want to know . . .

Seventh Annual UA Educational Training Program Lauded As Finest Example Of Industry Cooperation

HOW EDUCATION is helping to solve problems of a country, of a union, and of the pipefitting industry was demonstrated August 15 to 19 at Purdue University. The scene was the "Seventh Annual Apprentice Contest and Instructor Training Course" program, sponsored by the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry.

Ninety-eight contestants, representing 40 states and six provinces of Canada, participated in the weeklong test of written examinations and laboratory work.

First place winner in the pipefitter's division was Charles M. Dunn, Local Union 420, Philadelphia, Pa., who was awarded a cash prize of $1,000. Thomas Braden, Local Union 601, Milwaukee, Wis., placed second, winning $500; and Richard J. King, Local Union 464, Omaha, Nebr., finished third, receiving $250.

The first place winner in the sprinkler fitter's division was Bruno Polak, Jr., Local Union 281, Chicago, Ill., who also won $1,000. Second place went to Donald N. Sandberg, Local Union 669, Washington, D.C., who received $500. Francis J. Riegerix won third place and $250.

The meeting represents the high point of the UA's program of education for its members. Apprentices are encouraged to become proficient in their skills by the prospect of winning an all-expense paid trip to the university to compete for international honors and cash prizes. Local and state elimination contests are held to choose the contestants.

Concurrent with the competition, local union and vocational school teachers receive instruction from Purdue staff members and industry representatives.

Specifically, the instructor training course is designed to:

- Prepare UA instructors to become proficient in the use of ma-

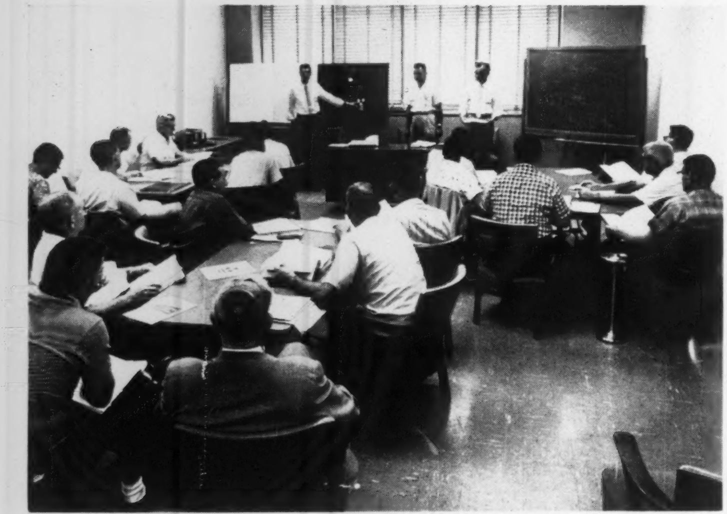
AWARDS CEREMONY PARTICIPANTS are, left to right, pipefitter division winners Richard J. King, third; Thomas Braden, second; and Charles M. Dunn, first; U.S. Secretary of Labor James P. Mitchell; and UA officials, Peter T. Schoemann, president; John J. McCartin, asst. president; William C. O'Neill, secretary-treasurer; and Martin J. Ward, asst. secretary-treasurer terials and techniques of instructing, particularly, instructional materials prepared and/or recommended by the UA.

- Acquaint instructors with the philosophy and principles of education, particularly, trade and industrial education.
- Provide learning experience in the principles and the fundamentals of the applied knowledge subjects such as science, mathematics, drawing, English, and the like.
- Broaden the understanding of the instructors in the technical aspects of the crafts and bring information to the instructors about the latest developments in this area, as well as in the skills phase of the work of pipefitter journeymen.

A title: "Certified Instructor of Journeymen and Apprentices in the Plumbing and Pipe Fitting Industry" is conferred by Purdue on those who satisfactorily meet the requirements for completion of the training program. The complete course requires attendance at five summer sessions, each consisting of five working days.

To finance this and other training programs, the UA and the National Construction Association established the International Training Fund in 1956. Under its provisions, employers contribute 2½ cents for each hour of work performed by journeymen or apprentices. Grants from this fund go to local joint apprenticeship committees to advance their training activities. Over $1,820,343 has already been distributed to 213 groups.

The need and value of this type of program was illustrated by the many speakers at the awards presentation meeting that climaxed the five day event. General president of the UA, Peter T. Schoemann, said that it is imperative for our national defense that apprentices and journeymen acquire the technological knowledge that will enable them to make missile installations and other defense projects.


BACK TO SCHOOL to learn latest teaching methods are these UA instructors during week at Purdue

Joseph Kearney, president of the Mechanical Contractors Association of America, expressed his hope that the training had prepared the apprentices to initiate ideas that would further improve the industry. He told the assembled group of over 1,000 contestants and guests that with hard work, honesty, and loyalty, combined with careful planning, the apprentices would not be disappointed.

The program, said Lawrence Rogin, director of education of the AFL-CIO, shows how "the university and the union, working with management and using the tools of education, can make progress for all."

Just how far technology has advanced in recent years was summed up by the main speaker of the evening, U.S. Secretary of Labor James P. Mitchell. The skilled worker of yesterday, said Mr. Mitchell, "is no more related to the skilled worker of today than the intricate piping of a missile installation is to the piping in a bathroom." He made known the fact that members of the UA helped build the first atomic plant.

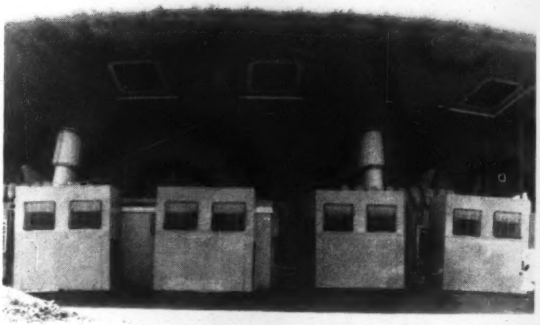
Mr. Mitchell went on to say that the seventh annual program was "one of the finest examples in America in which trade unions and management cooperate in moving toward a better way of preparing men for the future."

Nuclei Detector Helps Keep Air "Cleaner than Arctic"

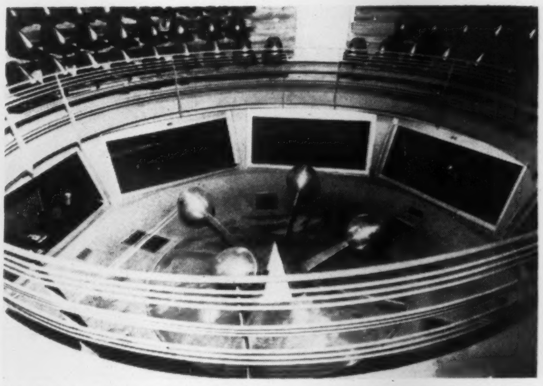
Air in a part of a new General Electric Co. power tube factory is cleaner than the air in the arctic, according to the company. The comparison was made by the company's general engineering laboratory that has been conducting regular tests of the air in the "Snow White" room where minute parts of television camera pickup tubes (image orthicons) are assembled.

Tests of the air cleanliness in the tube factory are made with a condensation nuclei detector. The device can measure particles from 0.001 micron (0.000000039 of an in.) to 0.1 micron.

Air filtration, air conditioning, frequent vacuum cleaning, air locks for entry and exit, use of lint-free clothing, hats, and rubber finger cots are used to eliminate the dust particles.



BEHIND THE SCENES are four 7½ hp condensers used to accommodate the 230 passenger saucer



EIGHT BAYS contain translucent screens which show films of vertical ascent over 10 cities

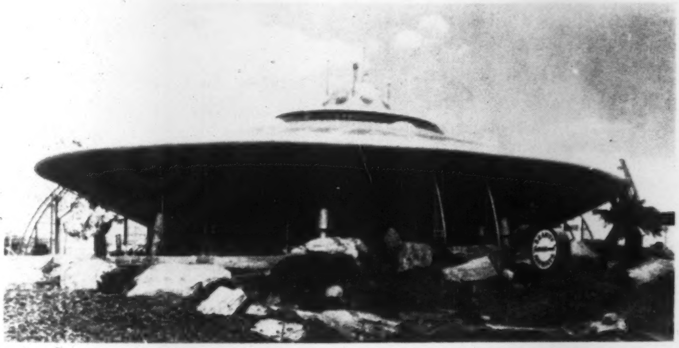
How to Air Condition a Flying Saucer

THE NEXT TIME you're called on to air condition a flying saucer might be a good time to get in touch with Daniel J. Hunt, New York City project engineer for the Controlled Weather Corp. Hunt has had experience! His latest job was to air condition a 230 passenger number for Freedomland, U.S.A.

Unfortunately though, the flying saucer doesn't fly. Freedomland is a $65 million amusement park in the Bronx, and the saucer is one of the many rides Hunt had to air condition.

The ship, with a circumference of 150.8 ft and an interior area of 1,809.056 sq ft, has no windows. A special 360 deg film process involving eight cameras and projectors provides the passengers with a simulated sight-seeing trip over North and South America. The movies are projected on translucent screens situated in the bay area.

Thirty tons of air conditioning capacity were required for the passengers' comfort, maintenance of the proper humidity for the movie cameras and film, and the elimination of dust in the projection area. Four 7½ hp condensers are used to accommodate the load, according to Chrysler Airtemp Div. of the Chrysler Corp.



Solving Air Conditioning Problems in a TV Studio

MANY PROBLEMS are encountered when designing an air conditioning system for a large radio and TV studio. WTAR radio and television center in Norfolk, Va., recently expanded and found this true when they decided to air condition their entire building. The station is in a building 100 ft long, 49 ft wide, and 35 ft high. The main studio is located in the center of the building which has few outside openings other than the main entrance. This required the use of a year 'round air conditioning system with provision for admitting maximum outside air.

Problems encountered included extensive use of electricity and resulting sensible loads which required large air volumes; need for quiet operation; rapid and heavy impact on the system when the main studio was in use for "live" TV broadcasts; sudden drop in load requirements when broadcast reverted to network operation; and the necessity for arranging air distribution so as to avoid the physical properties; plus electronic and lighting devices.

Secondary problems were caused by a very heavy load in small spaces such as the main control room. Some offices also required separate zoning because they were located on outside walls.

Two 40 hp reciprocating compressors are installed on the second floor of the building, adjacent to the main studio. They are mounted on double rubber-in-shear

you'll want to know

isolators set on 4 in. channels and secured to a concrete pad poured with the compressor room floor. Other main components of the system are located on the building roof, according to The Trane Co.

Two evaporative condensers, properly coated for preservation and sound absorption, are outside on the roof. They are also supported on rubber-in-shear isolators. Both units are equipped with bypass arrangements.

Air handling equipment is in a roof penthouse. It consists of a large builtup unit to supply the main studio and a factory-built central station air handling unit to serve the other zones.

The large builtup unit consists of a 49 in. centrifugal fan that will move 18,000 cfm of air, three evaporator coils with a total face area of 27 sq ft and three steam heating coils with the same face area.

The central station unit has a 10,500 cfm capacity. Seven reheat coils are installed in the ductwork to the seven zones. On the first floor these zones include a control and projection space, a clients' viewing and projection room, and offices at the front of the building. On the second floor the unit serves offices in the rear, plus storage space.

To secure a quietly operating system, careful attention was given to the tip speed of fans. Air supplied to the main studio passes through a sound trap. The duct is divided into 9 in.-wide passages by vertical sheet metal pieces which are completely covered with ½ in. sound absorption material. The air return from the main studio is handled in much the same way as the air supply.

A continuous exhaust from the upper level of the main studio is maintained to reduce excessive heat gain from studio lights. A 2090 cfm fan is used for this purpose.

Heating is provided by steam from an existing steam plant and controlled by steam valves.

L. E. Huybert, Jr. and A. L. Land were the mechanical and electrical engineers. The mechanical contractor was the Cos-Frank Corp.

In Memoriam. . .

Arthur Cutts Willard
1878-1960

Dr. Arthur Cutts Willard, 82, University of Illinois president emeritus and one of the nation's leading heating, ventilating, and air conditioning engineers, died in an Urbana, Ill., hospital Sept. 11 following a heart attack.

President Willard came to the University of Illinois in 1913 as an assistant professor of heating and ventilation in the mechanical engineering department. He progressed through the ranks to a full professorship, and became head of the mechanical engineering department in 1921, which position he held until 1934 when he was named president of the University of Illinois. He was one of the most distinguished presidents of the University serving from 1934 to 1946.

Dr. Willard was an engineer, teacher, and administrator, and after his retirement in 1946 he continued as a valued counsellor. He was consulted in the heating problems encountered in the National Army Encampments in 1917 which led to the beginning of the long established cooperative research program in heating, ventilation, and air conditioning at the University. This program is continuing today after 42 years of notable contributions.

Two major projects which brought Dr. Willard national recognition were his consulting work on the design of the ventilating systems for the Holland Tunnel and for the Chicago subway. He also served as a consultant for the Bureau of Mines and the U.S. Public Health Service.

He was a member of the American Society of Heating and Ventilating Engineers, serving as president in 1928-1929. In 1934 he received the F. Paul Anderson award from the Society. He was also a member of the American Society of Mechanical Engineers, the Society for the Promotion of Engineering Education, and many others.

The memory of Dr. Willard will remain long in the lives of all who knew him. The heating, ventilating, and air conditioning industry especially owe much to the contributions he made. He not only contributed directly in services rendered, but also contributed indirectly through his former students, associates, research activities, teachings, writings, and his example of principles, standards, integrity, courage, and leadership.

ASA Approves Standards On Flanges and Fittings

Two publications containing revisions in standards for cast-iron pipe flanges and flanged fittings has been approved by the American Standards Association. The publications are available from The American Society of Mechanical Engineers.

Entitled American Standards, Cast - Iron Pipe Flanges and Flanged Fittings, B16.1 - 1960, Class 125, and B16.2-1960, Class 250, the publications supersede B16.1-1948 and B16.6-1944, respectively. They incorporate intermediate pressure-temperature ratings and special requirements for testing flanges which are part of, or attached to equipment.

Class 125 refers to the maximum saturated steam service pressure of 125 psi for flanges and fittings; Class 250 refers to a maximum steam pressure of 250 psi.

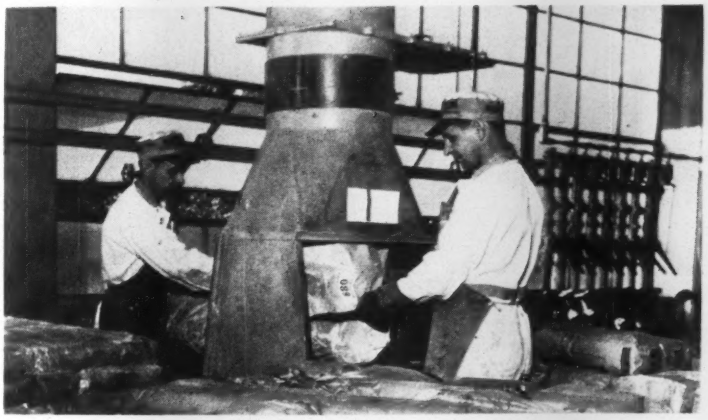
Copies of the publications are available at a nominal charge from the ASA, Dept. PR. 173, 10 E. 40th St., New York 16, N.Y., or from ASME, 29 W. 39th St., New York 18, N.Y.

Cleaner Air Week To Begin October 23

"Cleaner Air Week," which has won the endorsement of President Eisenhower and other national leaders, is broadening its horizons this year, according to Harry Belyea, president of the Air Pollution Control Association.

Mr. Belyea cited four principal objectives of this year's observance, October 23-29.

- Better and wider community understanding of local air pollution control problems.
- Broader acceptance of the community-wide approach to air pollution control.
- Awareness of air pollution control achievements.
- Recognition of APCA as "North America's voice for air pollution control."



Dust Collector System Eliminates Both Dust and Paper Bag Problems

An installation of a dust collector system not only has eliminated a troublesome dust problem, but has provided a satisfactory method of disposing dusty paper bags at the Rust-Oleum Corp. plant in Evanston, Ill.

A considerable amount of dust is created when the bags containing dry pigment are opened. This dust, however, and the bags, are drawn into the ductwork leading to the dust collector. Both enter a plenum chamber adjacent to the collector. The bags strike a baffle plate and fall to the bottom of a hopper and are removed by a large rotary valve. The dusty air continues on into the collector, according to the Wheelabrator Corp.

Commerce Dept. Eliminates Product Identification in Standards

Commercial Standards of the U.S. Dept. of Commerce will no longer contain product identifying marks that make reference to industrial firms, trade associations, or other organizations, it was announced recently. The information came from a new policy statement made by John C. Green, director of the Office of Technical Services, Business and Defense Services Administration, of the Department.

Mr. Green said the purpose of the change is to avoid any implication of endorsement by the Department of any particular producer or private organization.

The new policy will be applied uniformly to all new commercial standards, and to all pending and future revisions of existing standards. However, the change will not require immediate revision or amendment of standards already containing such grade trademarks and product identifications. It will be applied when revision is otherwise desirable.

Construction Contracts Reach Year's Highest Level in July

Sharp gains in the heavy engineering sector sent construction contracts in July to $3,596,909,000. This was the highest monthly total so far this year, according to the F. W. Dodge Corp.

However, the July 1960 total was 2 percent below the level of the month in 1959.

Heavy engineering contracts amounted to $1,115,686,000, up 44 percent over a year ago. Con-

you'll want to know

tracts for non-residential buildings totaled $1,151,980,000, down 3 percent.

Gas Pipeline Construction Doubles Pace

NEW PIPELINES and building compressor stations are being constructed at a rate double that of a year ago, according to the Gas Appliance Manufacturers Association.

Over 11,500 miles of gas pipeline, and compressors are now under construction or have been recently completed. Total cost of these operations is close to $1.2 billion.

These figures represent the totals of projects authorized by the Federal Power Commission during calendar 1959. They are double the corresponding amount approved by the FPC in 1958.

In the first four months of 1960, the FPC authorized major projects amounting to $76,976,000.

These projects, as well as the major projects of 1959, are detailed in the 1960 edition of GAMA's "Natural Gas Construction Data." Copies are available at a nominal charge from the association at 60 East 42nd St., New York 17, N.Y.

U. S. Cooling Equipment Seen 'Round the World

MORE than 54 million people in 28 foreign lands have seen and experienced the effects of American air conditioning equipment during the past five years. This has been made possible by exhibits staged by the U.S.A. at some 90 international trade fairs.

"Whenever and wherever the United States goes to an international trade fair," reports a spokesman for the Office of International Trade Fairs, "American air conditioning equipment goes along."

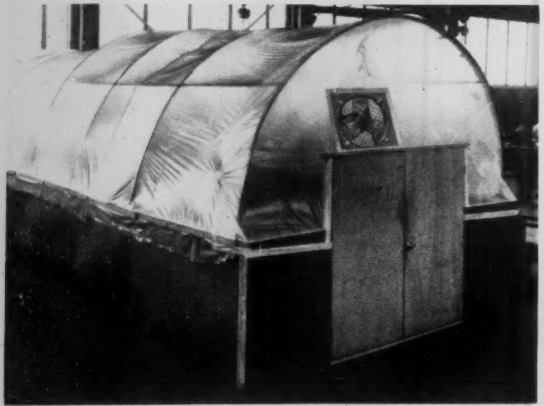
In a special report prepared by the Office at the request of the Air-Conditioning and Refrigeration Institute, it was disclosed that modern air conditioning systems have great impact on people of other lands. The fairgoer who feels the breath of freshness and complete comfort in an air conditioned exhibit area, gains respect for an ingenious and progressive America. And this reaction helps build potential markets for U. S. cooling equipment in every corner of the world.

Portable Clean-Room Eliminates Airborne Particles For Critical Tube Bundle Welding Operations

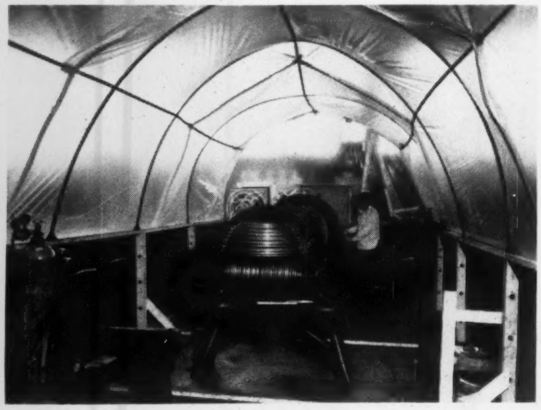
WELDING OPERATIONS on heat exchanger equipment are now being made without the threat of airborne dirt and contaminants at the Walden plant of the American-Standard Industrial Div., in Buffalo, N.Y. A portable, expandable clean-room is being used to maintain a rigid control of these particles.

Constructed in 6 ft lengths, the room can be expanded to fit virtually any size of feedwater heater tube bundles. Its hardboard side panels and polyethylene semicircular top facilitate quick assembly and dismantling, enabling its transfer to any part of the plant.

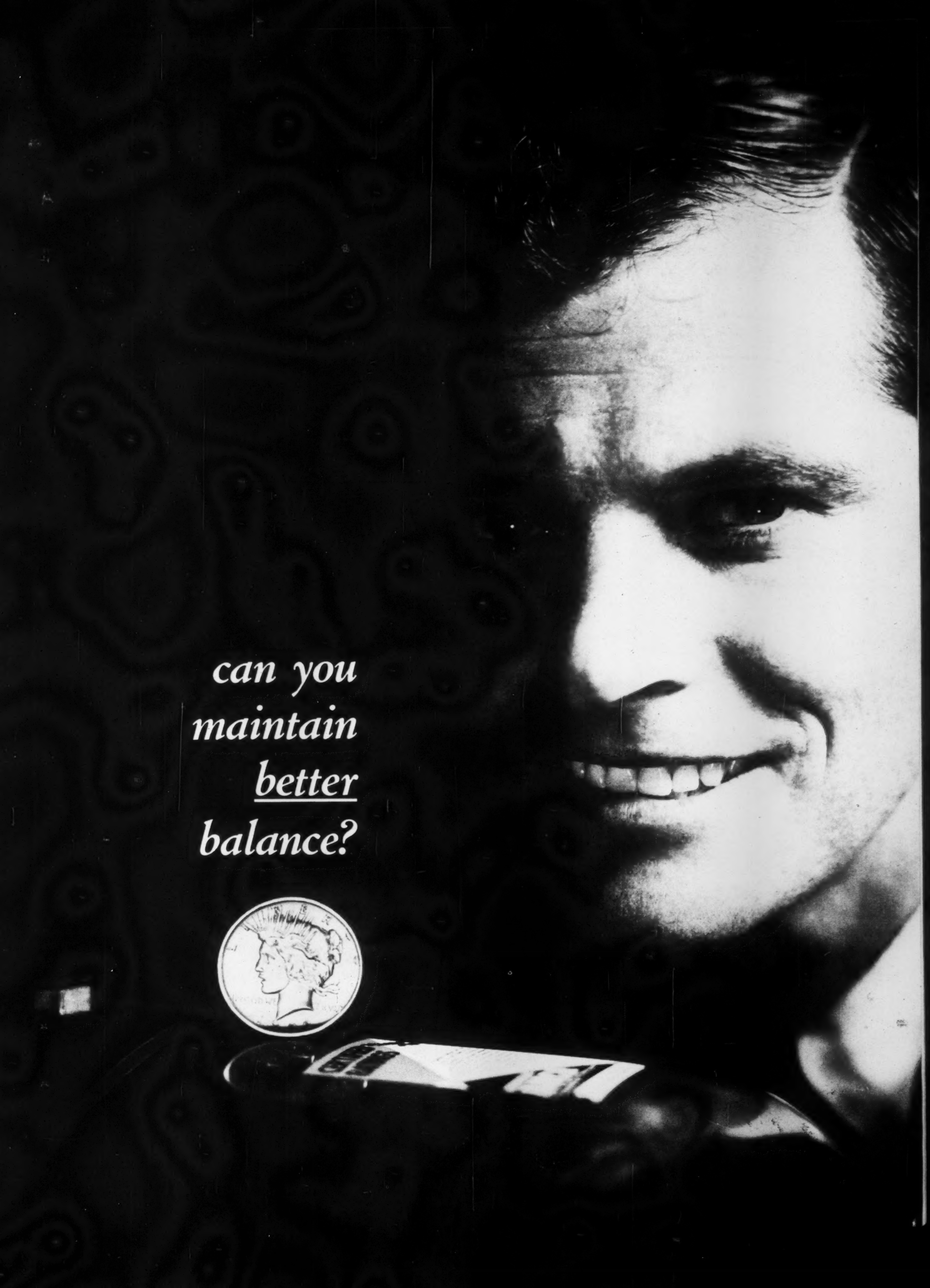
A fan on the inlet draws air through a filter into one end of the room. Another fan at the opposite end forces air out to maintain a continuous flow of contaminant-controlled air.

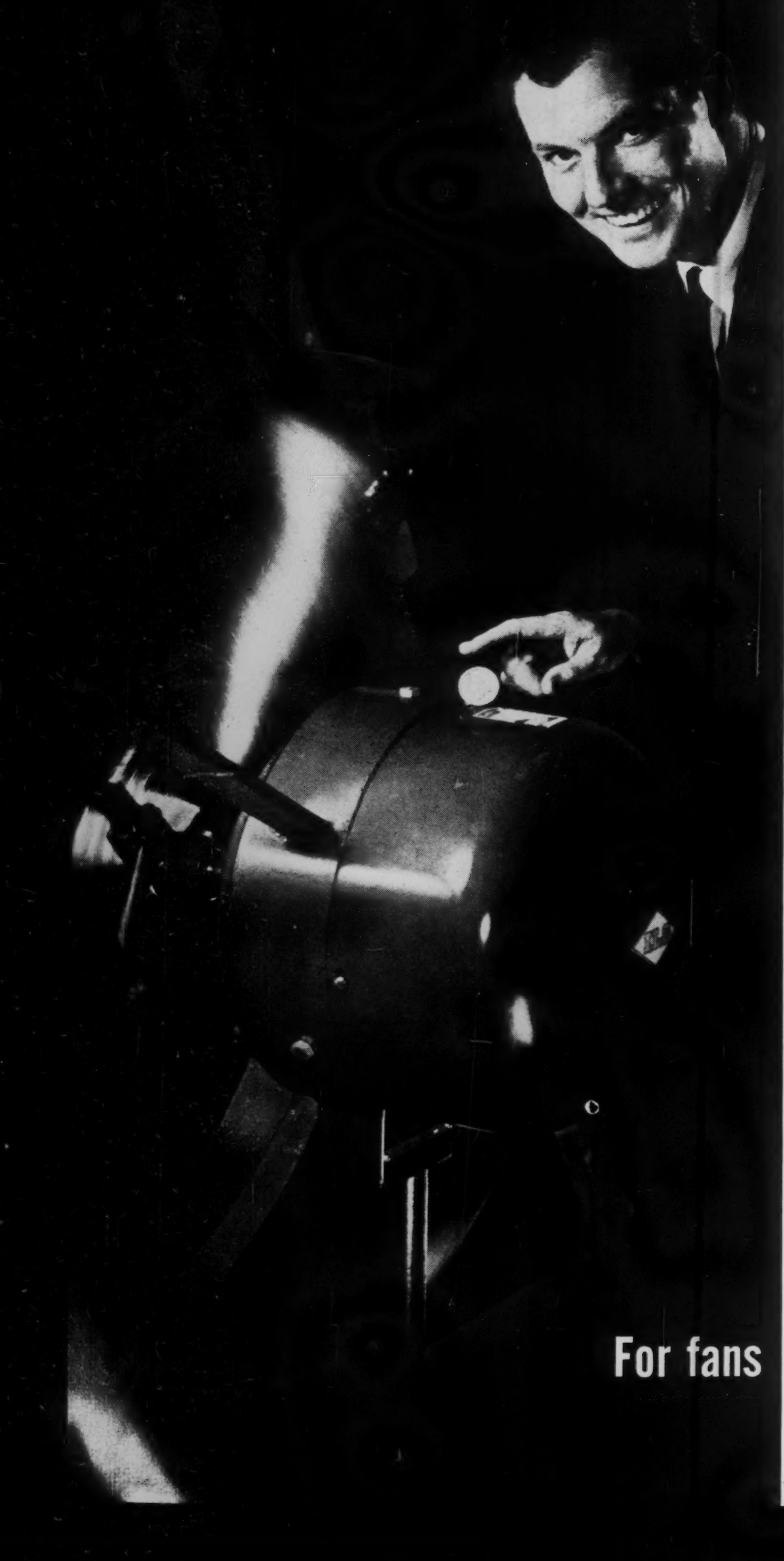


EXHAUST FAN above doors of portable clean-room maintain a continuous flow of contaminant-controlled air



INSIDE, critical welding operations can be made without fear of dust particles causing operational unreliability


can you
maintain
better
balance?



When you get ILG® you're "in balance"

Stand A Silver Dollar on its edge . . . on the *motor* of a direct-connected Ilg 42-inch fan. Flip the starting switch so the fan runs at full speed. *And the coin stays standing*! This smooth-running, precision-made fan helps explain why maintenance ceases to be a problem when you specify Ilg.

You *eliminate* vibration with Ilg fans and ventilators. Careful dynamic balancing of all component parts . . . electronic checks of direct-connected motors and fan wheels — both before and after final assembly — make certain that smooth, silent, *maintenance-free* operation

"Check-Out" Time. Every Ilg-built propeller fan wheel must pass rigid dynamic balancing "checks" before being direct-connected to Ilg-built, *self-cooled* 3-phase or permanent-split capacitor, single-phase motors. Ilg fans combine the cost operating advantages of *open-type* motors with the protection of *totally-enclosed* motors. Catalog DB1-100 shows how.

For fans built to satisfy your "specs"...

fans and ventilators,

on maintenance

is as much a part of each piece of Ilg equipment as our famous "One-Name-Plate" pledge of performance.

For further information, write for catalogs covering the complete line of Ilg electric ventilating equipment.

Each Ilg product shown carries the rating seal of the Air Moving and Conditioning Association, Inc.

CERTIFIED RATINGS

Certified Ratings are the result of tests made by the manufacturer in accordance with Standard Test Codes adopted by the Air Moving and Conditioning Association, Inc. Air Moving and Conditioning Association, Inc., is successor to Industrial Unit Heater Association, National Association of Fan Manufacturers, Inc., and Power Fan Manufacturers Association.

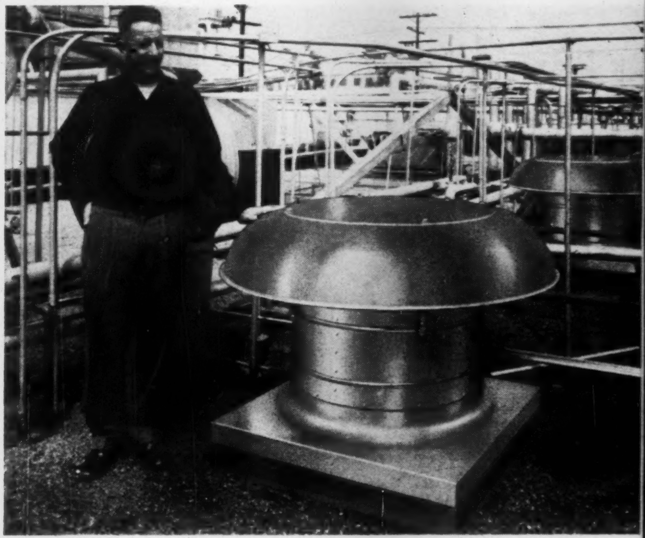
AUTHORIZED BY

AMCA

1957 AIR MOVING AND CONDITIONING ASSOCIATION, INC.

Your Choice of Util-A-Sets. 12 sizes of this new self-contained belt-driven centrifugal fan to choose from. Capacity range from 688 to 23,000 c.f.m. Both forward curved wheels and backward blade types. Motor mounting on rubber isolation rails checks resonant noise. Full line of accessories. See Catalog 3401.

Smooth Air Intake. Large intake area . . . with no inlet obstruction—combine to assure smooth intake of air. Backward curved airfoil blade design eliminates eddy currents and turbulence. Ilg BC *airfoil* centrifugals come in direct-connected and belted types. Standard construction suitable for Class I, II, III operations to 9" static pressure. Write for Bulletin 257.



Low in Height . . . High in Performance. Ilg LSQ roof ventilators feature direct-connected, patented "Q" fan wheels that pass air over blade smoothly. Low starting torque of Ilg 3-phase and permanent-split capacitor, single-phase motors eliminates starting shock, lengthens fan life. 11 sizes. Write for Bulletin 2302. For facts on type L-CRF *airfoil* centrifugal roof ventilators send for Bulletin 2701.

specify ILG®

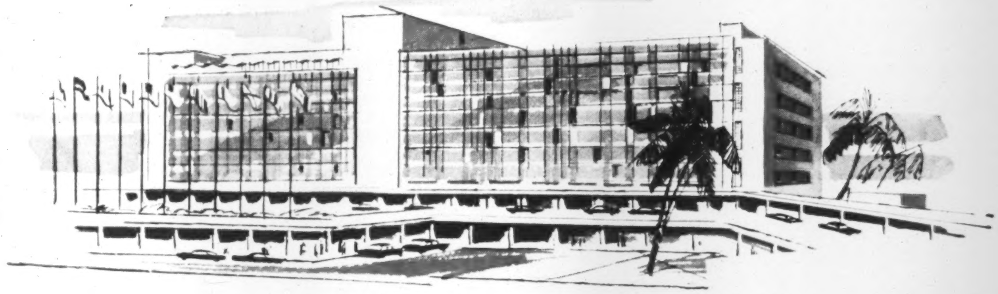
ILG ELECTRIC VENTILATING CO.
2826 N. Pulaski Road, Chicago 41, Illinois
Offices in 60 Principal Cities
Member of Air Moving and Conditioning Association, Inc. (AMCA)

Mr. Ed Smith, Miami Manager, The Poole & Kent Company,
Mechanical Contractors, says:

"Honeywell service really Miami International

Mr. Smith on the airport observation deck overlooking the Miami International Airport Hotel. Honeywell temperature control in the hotel keeps travelers as comfortable as possible.

paid off for us on the Airport Hotel job"



Architect: Steward-Skinner Associates
Consulting Engineer: Mitchell-Gordon Associates
General Contractor: Fred Howland, Inc.
Mechanical Contractor: The Poole & Kent Company

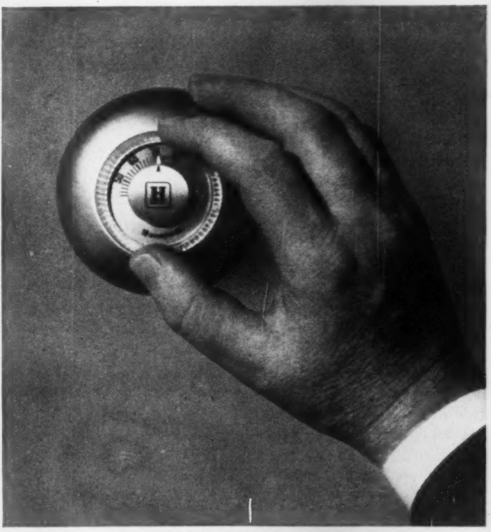
Engineers from Honeywell's Miami office were always available and eager to help

"When we installed the Honeywell temperature control system at the Miami International Airport Hotel," says Smith, "Honeywell men were ready to handle any problem encountered. But Honeywell engineers had planned the system so well, we were easily able to maintain job progress."

According to Smith, "This is very important to our operation. Accurate shop drawings . . . the right equipment . : . there can't be a slip-up, or unprofitable delays will be encountered. This isn't likely to happen with Honeywell men on the job. Honeywell supervises a job from start to finish; and the equipment is the best available."

You get more to work with when you work with Honeywell. Easily installed controls, accurate specifications, prompt delivery and excellent supervision are the advantages enjoyed by every contractor with Honeywell on his team.

Call your local Honeywell office for details. There are 112 conveniently located across the nation. Or write Honeywell, Dept. AC-10-116, Minneapolis 8, Minnesota. In Canada, contact Honeywell Controls, Limited, Toronto 17, Ontario.



The Honeywell temperature control system installed in the hotel includes 270 individual room thermostats.

Honeywell

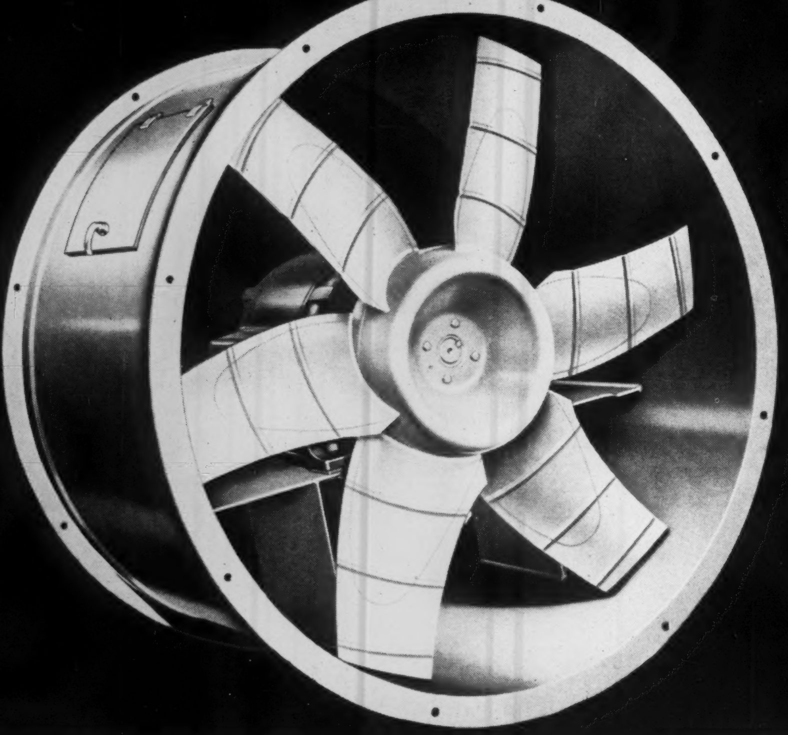
H HONEYWELL First in Control

SINCE 1885

75 YEAR PIONEERING THE FUTURE

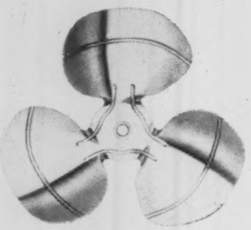
Sales and service offices in all principal cities of the world. Manufacturing in the United States, United Kingdom, Canada, Netherlands, Germany, France and Japan.

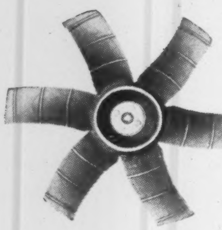
TRANE announces____



Duct type propeller fan is a heavy-duty axial fan for moving clean or contaminated air. Installed anywhere in the duct system. Model B fan blades. Available in 16″, 20″, 24″, 30″, 36″, 42″ and 48″ sizes. Direct drive type for simplicity, economy—or with belt drive for flexibility. Totally enclosed motors.

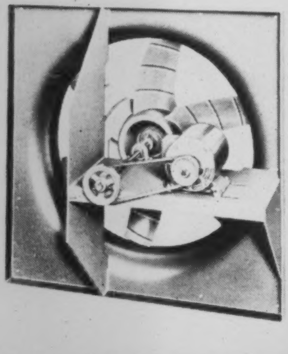
TYPE A BLADE is designed for general ventilation and exhaust. For low pressure applications. Features all-aluminum blades. 20, 25 and 30 degree blade angles for more versatile selection.



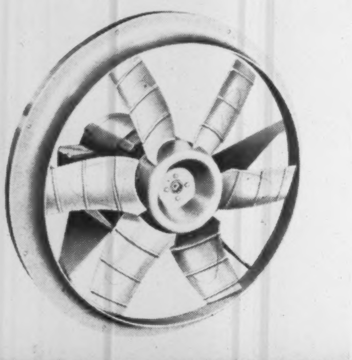


TYPE B BLADE is heavy-duty, to operate against pressures up to 1″. Large, spun-steel hubs. Main steel blades are electrically welded to a secondary steel blade. This makes for sturdy assembly, well equipped to withstand the stress of higher pressures. 3 or 6 bladed fan wheels; 10, 15, 20 or 24 degree angles.

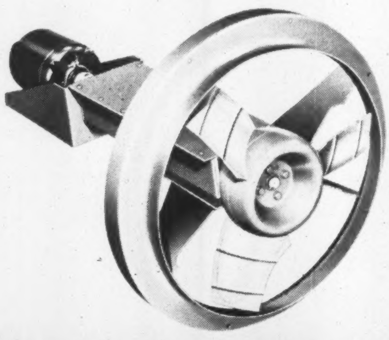
TRANE panel fan may be mounted on walls, ceilings or partitions. Model B blades are available in 36″, 42″ and 48″ sizes—belt or direct drive. Model A blades available in 11¼″, 13½″, 16¾″ and 19¾″—direct drive only. 25¼″ and 30″, in either belt or direct drive.



Orifice fan handles air through short duct runs; installed at duct inlet or outlet (or on wall). Model B blades; sizes: 16″, 20″, 24″, 30″, 36″, 42″ and 48″—belt or direct drive. The TRANE Orifice Fan is designed for a wide variety of both commercial and industrial applications.



Extended shaft fan is used where air or gas is handled at high temperatures; where air is very dirty or corrosive; to exhaust contaminated air. Model B blade type, direct drive, in 16″, 20″, 24″, 30″, 36″, 42″ and 48″ sizes.



—a new line of propeller fans with 266 standard combinations!

They're versatile. They're efficient. And they meet more air handling requirements—accurately!

Here is a big, complete line of propeller fans for industrial and commercial applications —from TRANE, leaders in fan design for over thirty years. These new axial flow fans will meet a wide variety of needs: dissipating fog over dye vats; exhausting fumes from pickling vats, welding smoke from fabrication areas; ventilating paint shops, chemical laboratories, oven rooms, factory and commercial offices, kitchens, laundries and other areas.

There are nine basic fan types in this new TRANE line; 2 blade types, seven blade angles; a total of 266 combinations with standard models to meet the most exacting specifications! And these propeller fans are economical: low in initial cost, low in operating cost. They're more efficient, too; capable of operating against higher resistant pressures. A major design feature on panel, orifice and extended shaft fans is the extended spun orifice ring that funnels air smoothly into the fan wheel to prevent turbulence, air leakage; assures a smooth air flow off the blades.

Developed in the TRANE "House of Weather Magic," these fans have been extensively tested in accordance with AMCA and ASHRAE standards. Sound tests, overspeed tests, pressure tests, have proven them dependable and rugged. And *every* fan wheel is given a running balance test to assure even, vibration-free performance.

WANT MORE FACTS? For specifications on the complete TRANE line of fans, just call your nearby TRANE Sales Office. Or write TRANE, La Crosse, Wisconsin.

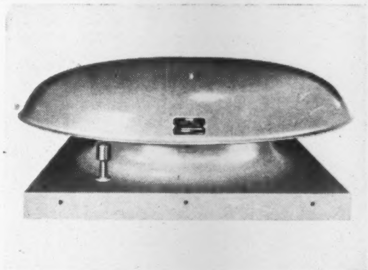
For any air condition, turn to

TRANE

MANUFACTURING ENGINEERS OF AIR CONDITIONING,
HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

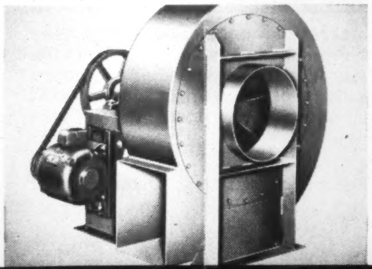
THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. DIV., SCRANTON, PA.
CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN. • TRANE COMPANY OF CANADA, LIMITED, TORONTO
100 U. S. AND 19 CANADIAN OFFICES

. . . there's a TRANE Fan for every job!

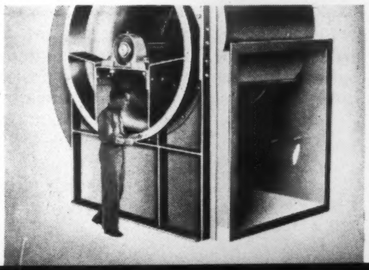


Axial roof ventilator provides economical ventilation for mills, factories, warehouses. Designed with lower silhouette, costs less to install and operate. 5 sizes. Models also for handling corrosive and explosive fumes and gases. Centrifugal roof ventilators also available.

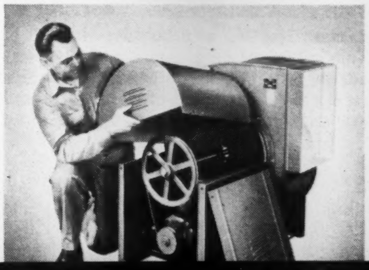
TRANE Industrial fans are available in 3 basic wheel types: A, for exhaust systems; B, for granule-conveying; S, for stringy material. 11 sizes, 11″ to 37″ inlet diameter; 5 arrangements to meet any process system need.

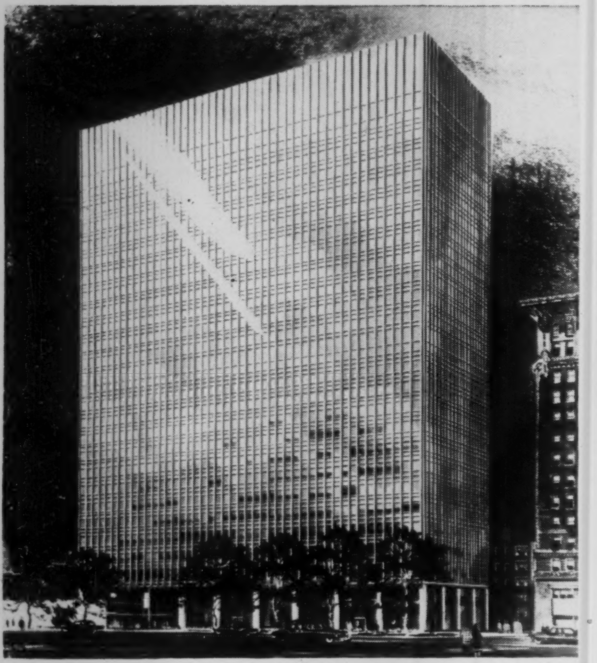


Class III fans are designed for high-pressure air conditioning systems, industrial processing and drying. 15 standard sizes from 18″ to 73″, for static pressures up to 11½″. Complete line of Class I and II fans also available.

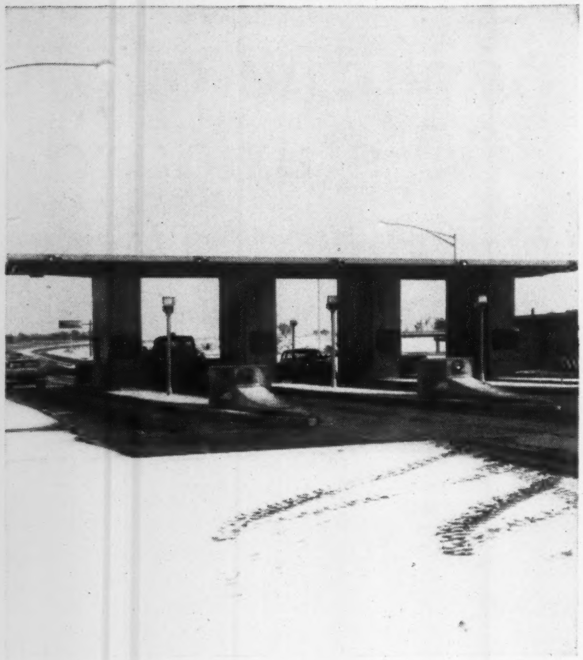


Packaged utility fans are designed for supply and exhaust in hundreds of ventilation applications. Advanced design features assure exceptionally smooth and quiet operation, long life. Available in capacities to 15,450 cfm.





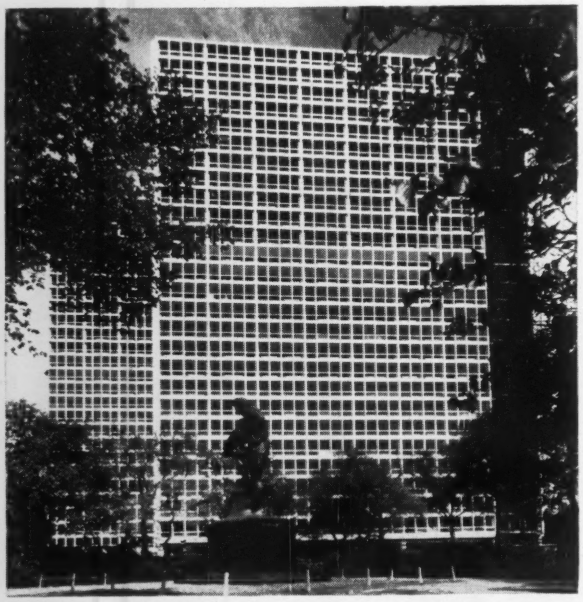
Vent and Drainage—Time-tested galvanized steel pipe gives assured maintenance-free service at low cost. That's why it is specified for drainage and vent lines in major buildings such as Cleveland's Illuminating Building, New York's Coliseum, the Seagram skyscraper and Socony-Mobil and Mutual Benefit Life Buildings.



Snow Melting—Beneath the toll gates of the Indiana Turnpike and the Calumet Skyway, as well as on the ramps of the New York Port Bus Terminal and Staten Island Ferry, steel pipe keeps pavement approaches clear of ice and snow for safe and controlled vehicular movement all winter through.

Steel pipe serves best in many ways . .

Radiant Heating and Cooling—In Salt Lake City's First Security Building, steel pipe serves a dual function. It carries steam for heating and chilled water for air conditioning. Logically, too, for steel pipe has proved efficient for heating and refrigeration, as well as icemaking, in over 70 years of service.



Electrical Conduit—When vital services depend on electricity, as in Chicago's Commonwealth Promenade Apartments, it's natural to protect this power with sturdy, rigid steel conduit. Imbedded in concrete, enclosed in walls or exposed—rigid steel conduit meets all local, state and national building codes.

Fire Prevention—Much of the nation's $1,100,000,000 annual fire losses might have been prevented if all structures were equipped with efficient, steel pipe fire sprinkler systems. The cost of such built-in, 24-hour fire protection, when related to potential losses, is truly an economical investment.

. . many places

Steel pipe is the modern metal tubular product easy to engineer and install.

Indoors or out, overhead or underground, in walls or exposed—*steel pipe* means durability and economy. It's easy to work, economical, readily available. It meets local, state and national codes. Its proved record of performance makes it the most widely used pipe in the world.

Steel pipe serves well and long in vital services affecting American life and business . . . for vent and drainage, fire sprinkler systems, snow and ice melting, radiant and conventional heating, air conditioning and gas, air, electrical and water lines.

In many ways and many places *steel pipe* serves best. To learn about how, why and where—consult your local *steel pipe* distributor or steel company representative or write the Committee's Research Engineers for specific application literature.

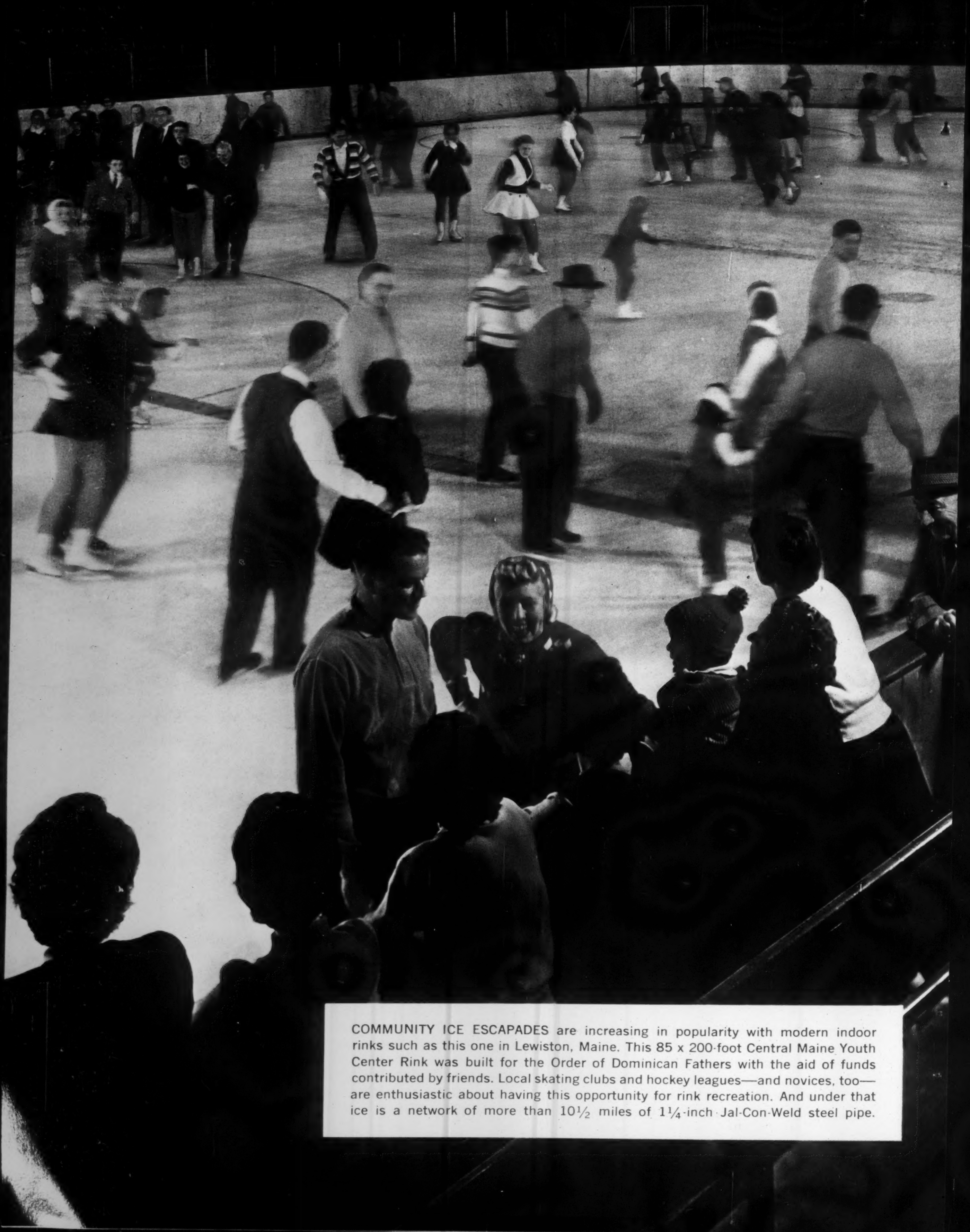
STEEL PIPE IS FIRST CHOICE

- Low cost with durability
- Strength unexcelled for safety
- Formable—bends readily
- Weldable—easily, strongly
- Threads smoothly, cleanly
- Sound joints, welded or coupled
- Grades, finishes for all purposes
- Available everywhere from stock

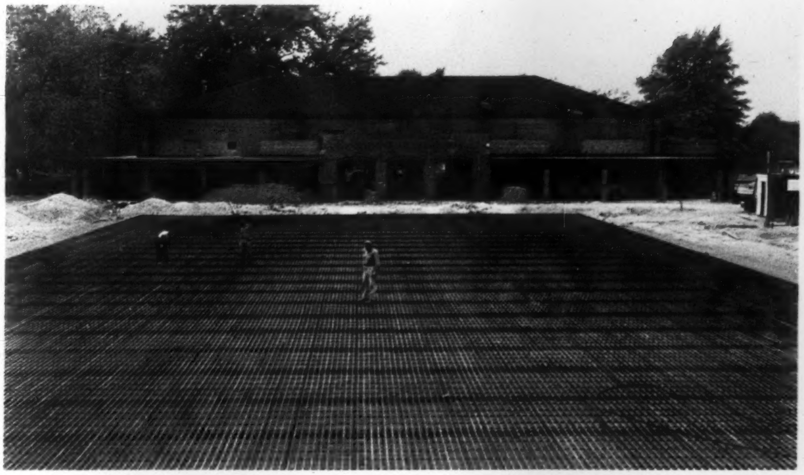
Insist on MADE IN USA Steel Pipe

C-5

COMMITTEE OF STEEL PIPE PRODUCERS
150 East Forty-Second Street, New York 17, New York



COMMUNITY ICE ESCAPADES are increasing in popularity with modern indoor rinks such as this one in Lewiston, Maine. This 85 x 200-foot Central Maine Youth Center Rink was built for the Order of Dominican Fathers with the aid of funds contributed by friends. Local skating clubs and hockey leagues—and novices, too—are enthusiastic about having this opportunity for rink recreation. And under that ice is a network of more than 10½ miles of 1¼-inch Jal-Con-Weld steel pipe.



New skating facilities have been added recently in two of Cleveland's public parks. Both rinks have utilized 1-inch J&L Jal-Con-Weld pipe. Architect—Damon, Worely, Samuels & Assoc. Contractor—Smylie Bros., Inc. Distributor—Clark Goodman Supply Co., Inc.

The Woodland Hills Park installation required over 9½ miles of pipe and 2,000 welds.

J&L STEEL

This cross trench shows arrangement of supply and return headers for the Central Maine Youth Center ice rink. Jal-Con-Weld pipe was selected because of its successful performance in similar installations over the past 15 years. Architect—Alonzo J. Harriman, Inc. Contractor—Jarvis Engineering Company. Distributor—Independent Pipe & Supply Corp.

America's Next Ice Age is on the move

What started it? It started with man-made ice and a new awareness of the genuine enjoyment to be found in skating. But nationwide interest in ice sports really began with the wide-spread application of dependable, low-cost refrigeration systems of *steel pipe*.

Steel piping systems, with their low initial cost and low-cost long-term maintenance, have made it possible for almost every community in the country to build an ice rink, permitting a full season of fall and winter skating.

Now, every year, more communities are building rinks wisely and economically with steel pipe. Many steel pipe rinks have been in operation for more than 20 years.

J&L's Jal-Con-Weld pipe is being specified for many of the new ice rinks. Close production control and rigid inspection assure a top quality product that will form and weld easily and provide dependable service for years.

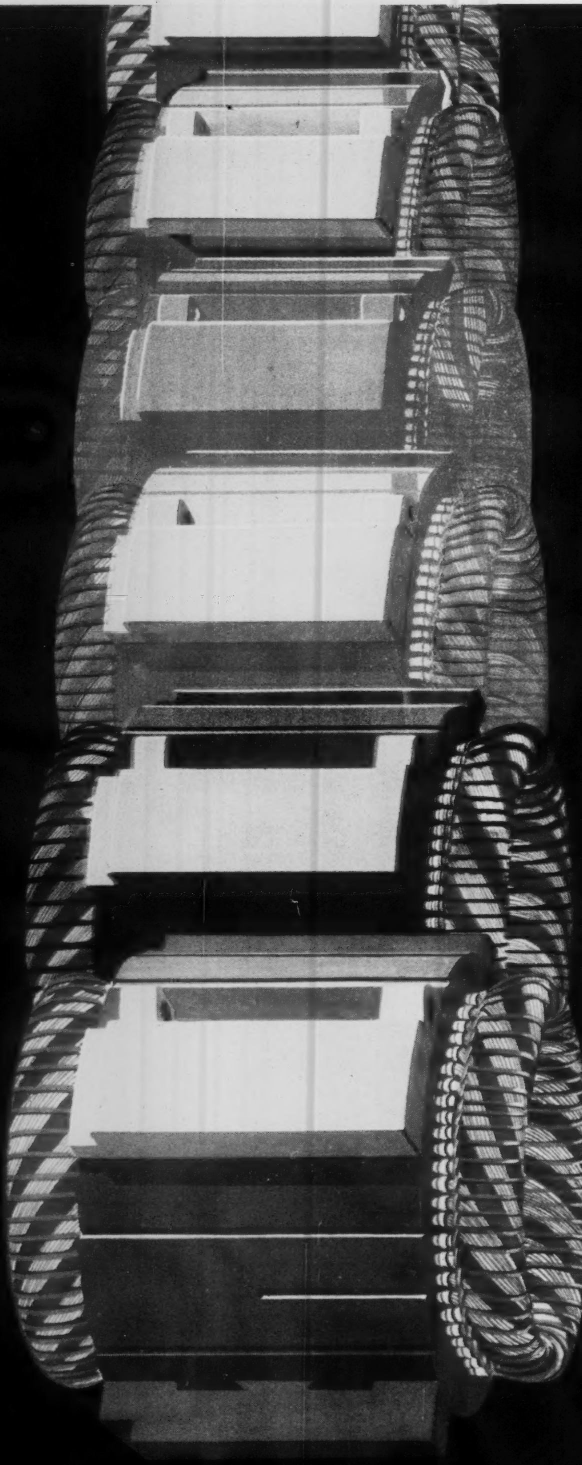
Ask your nearby J&L pipe distributor for details, or write direct.

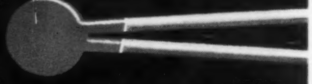
This Steelmark identifies products made of steel. Place this mark on your products. And look for it when you buy.

Steel

Jones & Laughlin Steel Corporation

PITTSBURGH, PENNSYLVANIA





THIS IS THERMISTOR . . . Guardistor motor's foolproof protection against dangerous overheating or burn-out. No larger than so many aspirin tablets, three of these devices are buried in stator windings. They sense temperature rise accurately, take into account all heat-producing factors.

NEW FROM WESTINGHOUSE . . .

NEW WESTINGHOUSE PACKAGED CHILLER LINE FEATURES EXCLUSIVE GUARDISTOR MOTOR

New compact design, prewired control center and double motor protection featured in PKB's

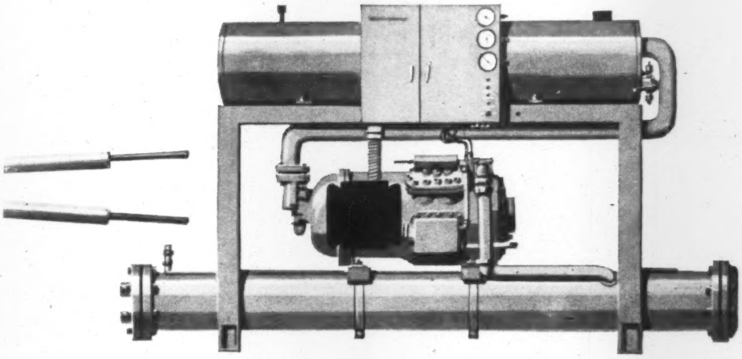
Westinghouse's new PKB Chillers are powered by the exclusive Guardistor* motors, offering you the most extraordinary motor protection you can buy in a chiller today. Embedded at three locations in the heart of the stator, Westinghouse's new thermistor devices sense temperature rises quickly and precisely to take the motor off the line before damage is incurred.

Here are other important features of the new Westinghouse line. Hermetic compressors built and backed by Westinghouse. Quick-trip overload heaters that provide 2 to 6-second starting protection even on a "cold" start. Complete control center mounted and wired. Optional across-the-line or part winding starters. Four-step capacity standard. In short, the finest package chiller in the industry. Eight sizes—20 through 100 tons. Twin compressor, 60 tons and up.

Available now from Westinghouse. Check your Westinghouse representative for full information, or write Westinghouse Electric Corporation, Air Conditioning Division, P. O. Box 510, Staunton, Virginia. You can be sure . . . if it's Westinghouse. J-85045

*Trade-Mark

Westinghouse



HOW WOULD YOU LIKE

...to double the profit from new air conditioning business?

...to keep more service men busy in the winter so they are available to install more jobs in the summer?

...to make a substantial profit from your service business?

...to schedule your service work instead of having your customers schedule it for you?

Carrier dealers and only Carrier dealers have this opportunity with CPS—Carrier Planned Service. CPS is just one of many exclusives that make the Carrier franchise the most valued in the industry. Interested in details? Call the Carrier distributor listed in the Yellow Pages. Carrier Air Conditioning Company, Syracuse 1, New York.

Carrier Air Conditioning Company

A DIVISION OF CARRIER CORPORATION

POWELL

WORLD'S LARGEST FAMILY OF

VALVES

performance makes the world of difference

POWELL BRONZE VALVES

Pictured here are a few valves offered by Powell to meet the demand for good, quality Bronze Valves. All kinds are available—gate, globe, angle, check, "Y", etc.—in all required sizes—for pressures from 75 to 2500 pounds.

The Powell Line includes valves in bronze, iron, steel, corrosion-resistant metals and alloys—just the right valves in the right sizes and materials to handle every flow control requirement, whether water, oil, gas, air, steam or corrosive fluids. Consult your Powell Valve Distributor—or write to us for illustrated literature.

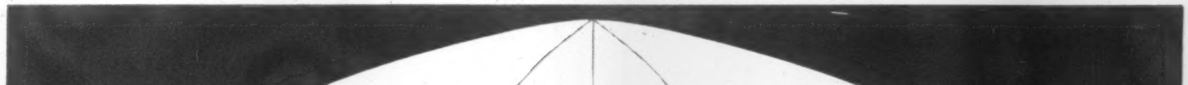


Fig. 2433—Bronze Regrinding Swing Check Valve for 150 pounds at 500F. 225 pounds W.O.G.

Fig. 375—Bronze Gate Valve for 200 pounds at 500F. 400 pounds W.O.G.

Fig. 2600—Bronze Full Flow Globe Valve for 150 pounds at 500F. 300 pounds W.O.G.

THE WM. POWELL COMPANY • DEPENDABLE VALVES SINCE 1846 • CINCINNATI 22, OHIO

JUST OUT!

A new line of Airfoil Bladed Fans with AMCA certified ratings

Now, from American-Standard Industrial Division comes a new line of Airfoil Bladed Fans that exceed 90% in mechanical efficiency. A completely new design, these fans carry AMCA certified ratings, and are built for both general ventilation and industrial process applications. They are available in 27″ thru 108¾″ wheel diameters—in single and double inlet designs, with volumes from 3000 to 500,000 cfm. Send for Bulletin A1103.

American-Standard Industrial Division, Detroit 32, Mich. In Canada: American-Standard Products (Canada) Ltd., Toronto.

AMERICAN-Standard PRODUCTS

AMERICAN-Standard
INDUSTRIAL DIVISION
AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS

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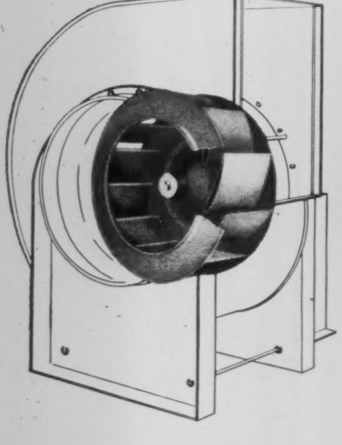


CERTIFIED RATINGS

Certified Ratings are the result of tests made by the manufacturer in accordance with Standard Test Codes adopted by the Air Moving and Conditioning Association, Inc. Air Moving and Conditioning Association, Inc., is successor to Industrial Unit Heater Association, National Association of Fan Manufacturers, Inc., and Power Fan Manufacturers Association.

AUTHORIZED BY AMCA

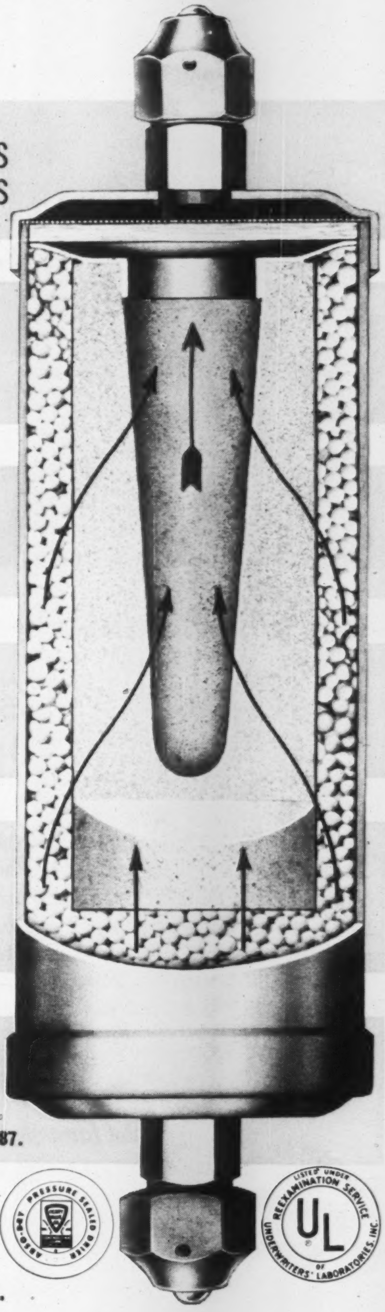
1957 AIR MOVING AND CONDITIONING ASSOCIATION INC

HENRY VALVE CO.

CONTROLLING FLOW SINCE 1914

"DRI-COR"® the High Flow... High Drying Capacity... Acid Removing... Refrigerant Filter-Drier with Granular Desiccant and Advanced Design Molded Core

The only molded core made by ceramic bonding of highly efficient desiccant particles. All inert fillers are removed by ceramic fire completely activating the core. Permits maximum flow and depth filtration at minimum pressure drop. Dryness assured by Abso-Dry® pressure sealing and Brass Flare Nuts.



CAPACITY RANGE	R-12 up to 20 TONS
	R-22 up to 25 TONS

DRI-COR Advanced Molded Core

Design Provides Uniform Core Porosity
No Inactive Cement or Binder

DRI-COR Two Stage Drying

Progressive Filtration . . .
500 P.S.I. Working Pressure

DRI-COR Drying And Filtering

Properly Proportioned . . .
Complete range of sizes

DRI-COR Low Pressure Drop

Transverse Flow for Rapid
Moisture and Acid Adsorption

DRI-COR Pressure Sealed

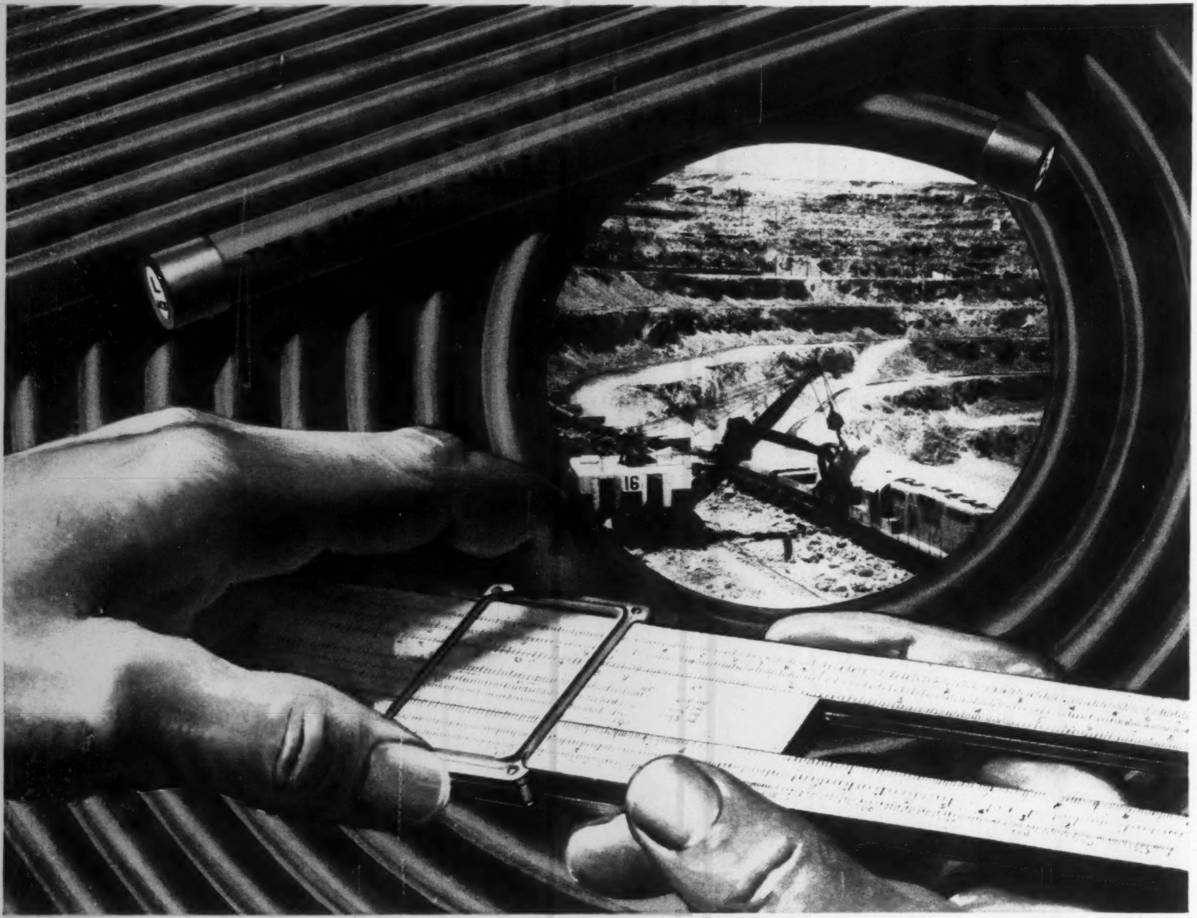
Permits Continued Desiccant
Reactivation Prior to Use

Also Available in Replaceable Cartridge Types . . . Write for DRI-COR bulletin V-87.

HENRY VALVE COMPANY

For Refrigeration, Air Conditioning and Industrial Applications

MELROSE PARK, ILLINOIS, U.S.A. CABLE: HEVALCO, MELROSE PARK, ILL.



HERE'S WHY SO MANY ENGINEERS SPECIFY

Phelps Dodge Copper Tube for refrigerating, air conditioning and heating units!

1 Phelps Dodge has complete control of its copper tube from original source to finished product. The copper used in Phelps Dodge tube comes from Phelps Dodge-owned open-pit mines, is smelted in Phelps Dodge refineries and fabricated in modern Phelps Dodge mills. This overall Mine-to-Market control is assurance of highest quality and finest workmanship.

2 Phelps Dodge devotes particular attention, throughout fabrication, to uniform anneal for tube flaring and careful control of die draw for close tolerance.

3 Phelps Dodge can supply maximum tube lengths and precise wall thicknesses engineered to customer specifications; straight length tube tempered to meet bending and expanding requirements.

4 Phelps Dodge multiple mill operation guarantees a steady source of tube supply to meet the needs of manufacturers and distributors of refrigerating, air conditioning and heating equipment.

It's the famous Mine-to-Market Quality Line . . .
sold the quality way—through authorized wholesalers!

AIR-CONDITIONING AND REFRIGERATION WHOLESALERS
A·R·W
ASSOCIATE
MEMBER

PHELPS DODGE COPPER PRODUCTS
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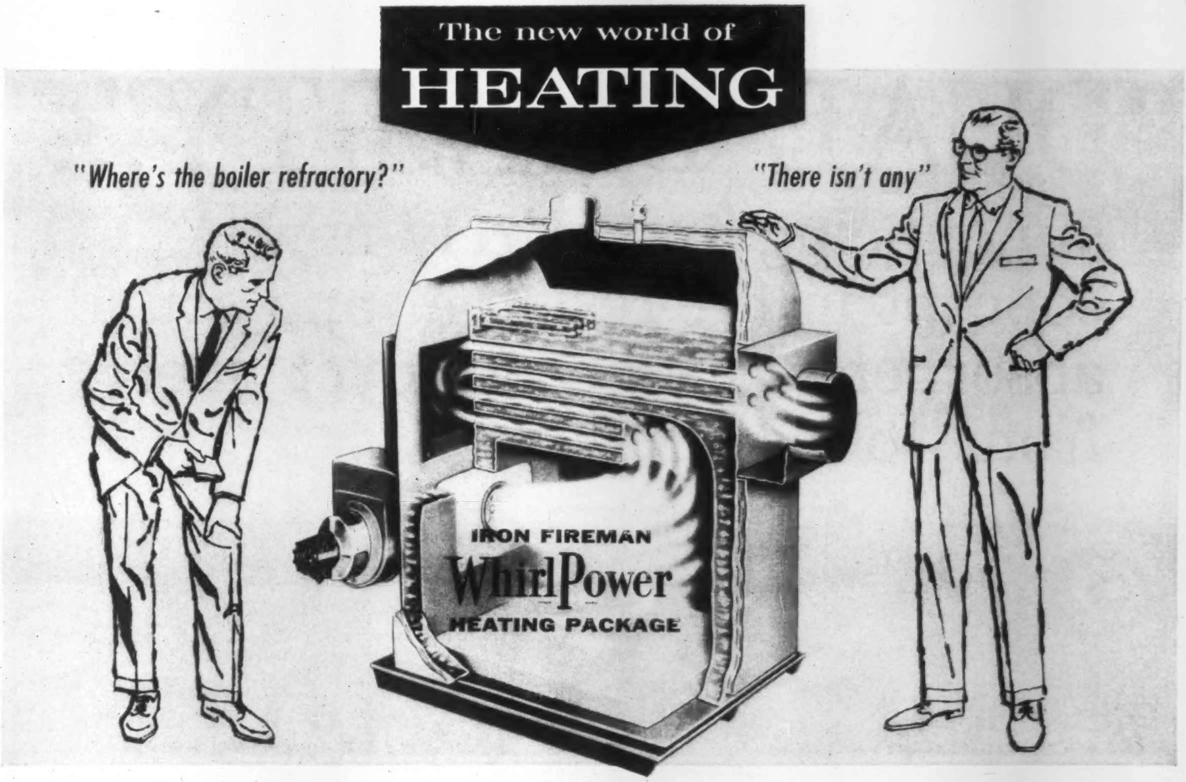


CLEAN FLAME *within seconds* FROM COLD START

No hot refractory needed to support combustion

The new WhirlPower heating package makes a clean flame in a cold firebox, because it does not depend for its combustion efficiency on the reflected heat of hot refractory. All conditions for *complete* combustion are created *within the fire-cone itself.* It starts clean and stays clean.

Whether firing oil or gas, the entire air supply is introduced through the firing port, under forced draft, into a sealed combustion chamber. Fuel and air are combined within a firing head of new and unique design. Since firebox pressure remains constant (unaffected by the uncertainties of natural draft) the air volume can be as accurately metered as the fuel supply.

Exceptional economies in fuel and maintenance

Iron Fireman WhirlPower combustion eliminates many causes of service. Most service calls result from sooted flues, fouled electrodes, dirty combustion controls, or by carbon-clogged nozzles, baked by the reflected heat of hot refractory. The considerable cost of refractory maintenance is also eliminated. With a high resistance to the passage of air through burner and boiler, and no draft-producing stack, standby losses are reduced to a minimum. This, plus high combustion efficiency, results in substantial fuel savings.

No stack needed; merely a vent

Forced draft and sealed combustion makes a high stack unnecessary. Only an exhaust vent or stub stack is needed, and this can be a third smaller than the usual flue diameter.

For gas, oil or dual-fuel firing—steam and hot water models

Single fuel models are available for either gas or oil. Dual-fuel models switch fuels instantly, either under manual or automatic control.

Mail coupon for full information and specifications

IRON FIREMAN

HEATING AND AIR CONDITIONING
AIRCRAFT COMPONENTS AND EQUIPMENT
MISSILE AND AIRCRAFT GYROSCOPES
ELECTRONIC EQUIPMENT
CONTROL INSTRUMENTS

Iron Fireman Mfg. Co., 3101 W. 106th St., Cleveland 11, Ohio
(In Canada, 80 Ward St., Toronto)

Please send full information and specifications on the WhirlPower Heating Package.

Name____________________

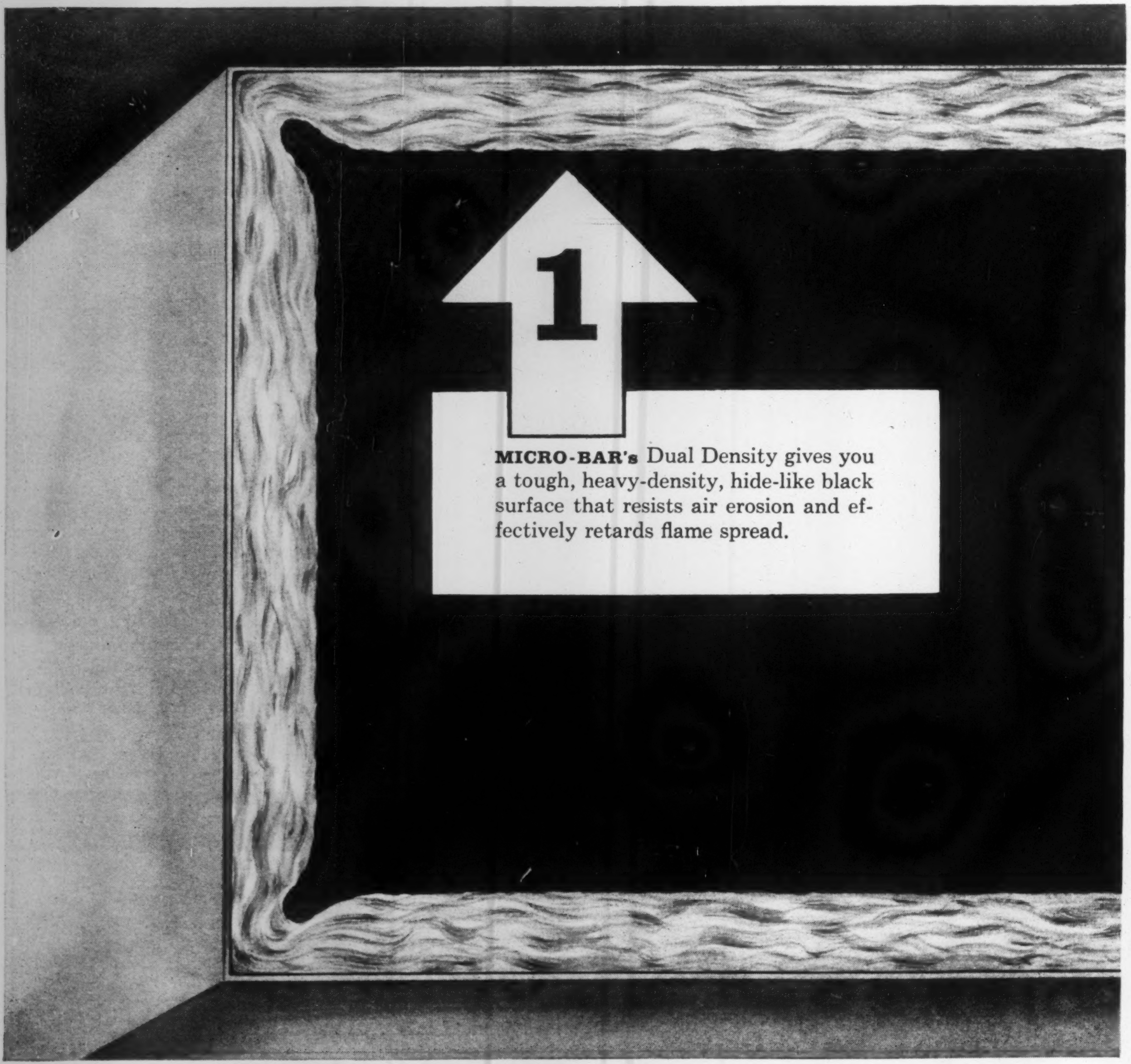
Firm____________________

Address____________________

City__________ State or Prov.__________

"DUAL DENSITY"...

announcing an entirely new concept in fire-resistant and sound absorbent Fiber Glass duct liner from Johns-Manville



MICRO-BAR's Dual Density gives you a tough, heavy-density, hide-like black surface that resists air erosion and effectively retards flame spread.

J-M's NEW

MICRO-BAR

GIVES YOU THESE
IMPORTANT ADVANTAGES:

- *Extremely Low Fire Hazard Rating*
- *Tough Surface That Resists Air Erosion*
- *Exceptional Acoustical Performance*
- *Eliminates Need For Metal Nosings*
- *Greater Holding Power For Pins*
- *Easy To Apply By Conventional Methods*

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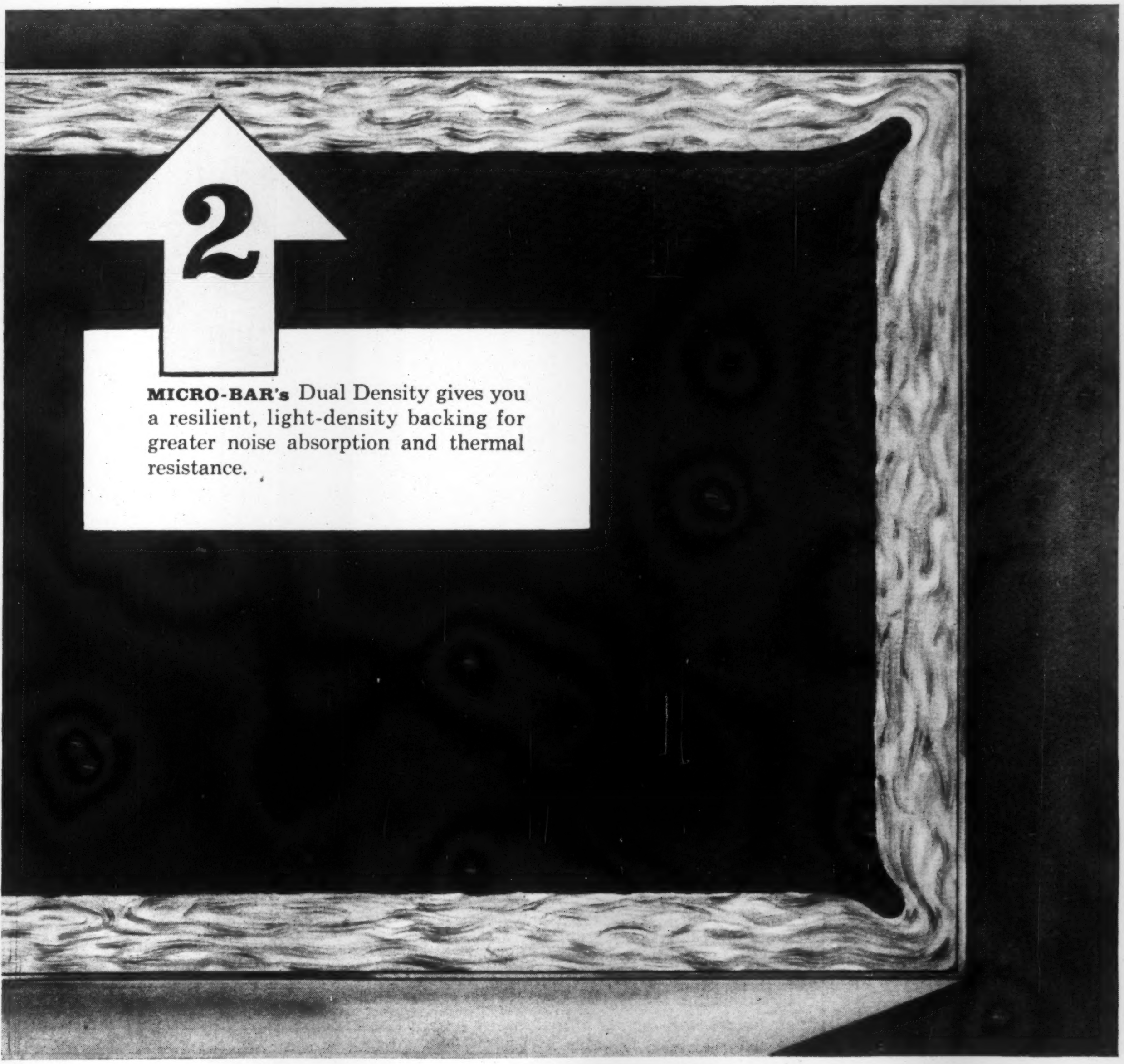
Underwriters' Laboratories, Inc.
®
INSPECTED
BATTS AND BLANKETS
Not Over 500 Sq. Ft. Issue No. F 141
FIRE HAZARD CLASSIFICATION (Based on 100 for untreated Red Oak)
Flame Spread 15 Fuel Contributed 25 Smoke Developed 5
L-3156 PRINTED IN U.S.A.

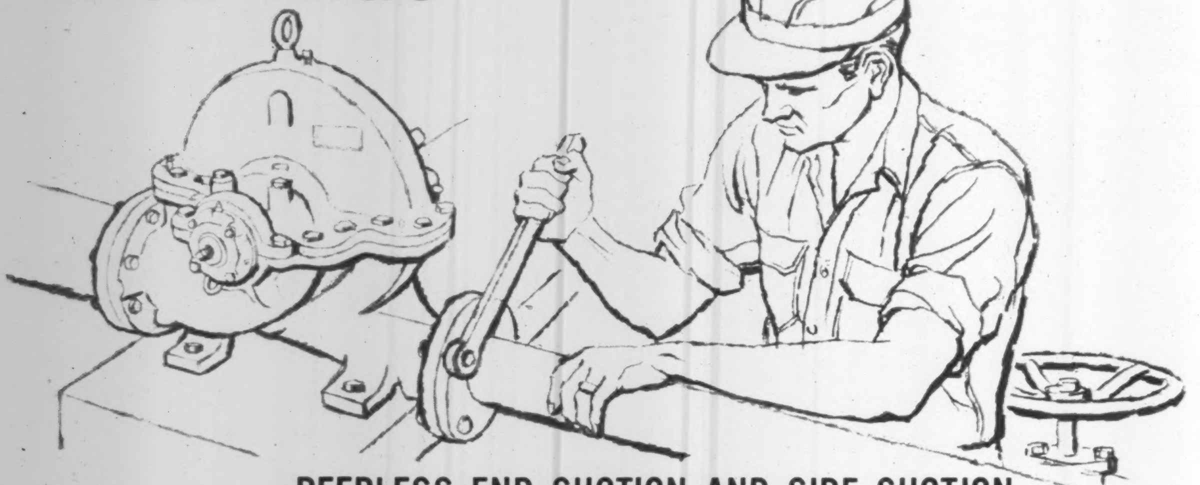
JOHNS-MANVILLE
JM FIBER GLASS



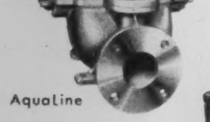
MICRO-BAR's Dual Density gives you a resilient, light-density backing for greater noise absorption and thermal resistance.

INSTALL THESE BETTER PUMPS WITH DOWN-TO-EARTH PRICE TAGS

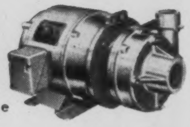
PEERLESS PUMPS



PEERLESS END SUCTION AND SIDE SUCTION AIR CONDITIONING PUMPS COST LESS—LAST LONGER



AquaLine



Fluidyne

PEERLESS AQUALINE® **Pumps** are available in sizes to 8-inches. Capacities to 2600 gpm, heads to 280 feet. Temperatures to 250°F. Horizontal split case design allows quick inspection without disturbing piping.

PEERLESS FLUIDYNE® **Pumps** are compact end-suction design. Redi-Packed in 22 sizes from 1 x 2 x 6 to 2½ x 3 x 10, for immediate shipment. Heads to 230 feet, capacities to 300 gpm, motors from 1 to 15 hp.

Priced right – That's the first Peerless economic factor you find in every Peerless AquaLine and Fluidyne water handling pump.

Quality Engineered – It is a factor that shows up on the higher performance ratings these pumps give you. And their remarkably trouble-free operation records deliver a full measure of customer satisfaction that's hard to beat.

Versatile–Outdoors or indoors, Peerless AquaLine and Fluidyne pumps meet the needs of hundreds of water handling services. Chilled water, booster service, in-plant, and cooling systems of all types are but a few of the many applications for which these pumps are ideally suited.

Immediate Availability–Close-by regional warehouses, plus two big factories place these pumps at your job in shortest time possible.

Get the full story now on Peerless AquaLine and Fluidyne pumps. Send for more information today.

ATTENTION DEALERS: A limited number of Peerless AquaLine and Fluidyne pump dealerships are available. Please write for complete information.

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Peerless Pump
HYDRODYNAMICS DIVISION

Offices:
New York; Detroit; Cleveland; Chicago; Indianapolis; St. Louis; San Francisco; Atlanta; Plainview; Lubbock; Phoenix; Albuquerque; Los Angeles; Fresno.
Distributors in principal cities.
Consult your telephone directory.

Peerless Pump, Hydrodynamics Division, Food Machinery and Chemical Corporation
2005 Northwestern Avenue, Indianapolis 8, Indiana
Gentlemen: Please send me immediately:
☐ Bulletin B-2319 on Peerless Fluidyne Pumps.
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☐ Name and address of nearest Peerless Dealer.

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SAVE and SELL
with these
HUSSEY COPPER TUBING ADVANTAGES

MATERIAL SAVINGS

Copper's durability—one of its outstanding properties—makes it possible to use thinner walled tube with smaller outside diameters for water lines and drainage, vent and waste systems. Result—a saving in both material and space. Its light weight permits handling of longer lengths. Result—fewer fittings. Soldered joints eliminate need for caulking, lead and oakum.

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With copper, site work is reduced because copper is easy to handle . . . easy to cut . . . requires no threading . . . solders quickly. Its long lengths mean fewer joints and faster fitting in the tight spots. Often, plumbing trees and even complete modular bathrooms can be prefabricated to save installation time and money.

QUALITY SALES FEATURES

Copper is a "sell-word" because customers know it as the sign of quality construction. It is broadly recognized for its long service without costly replacement and maintenance in all its many uses in construction. You can be doubly sure you'll get all the quality features of the ageless metal when you specify HUSSEY—a leading name in copper since 1848.

COPPER
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(Division of Copper Range Co.)
ROLLING MILLS AND GENERAL OFFICES
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MADE IN U.S.A.
TO THE STANDARDS
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7 Convenient Warehouses to serve you

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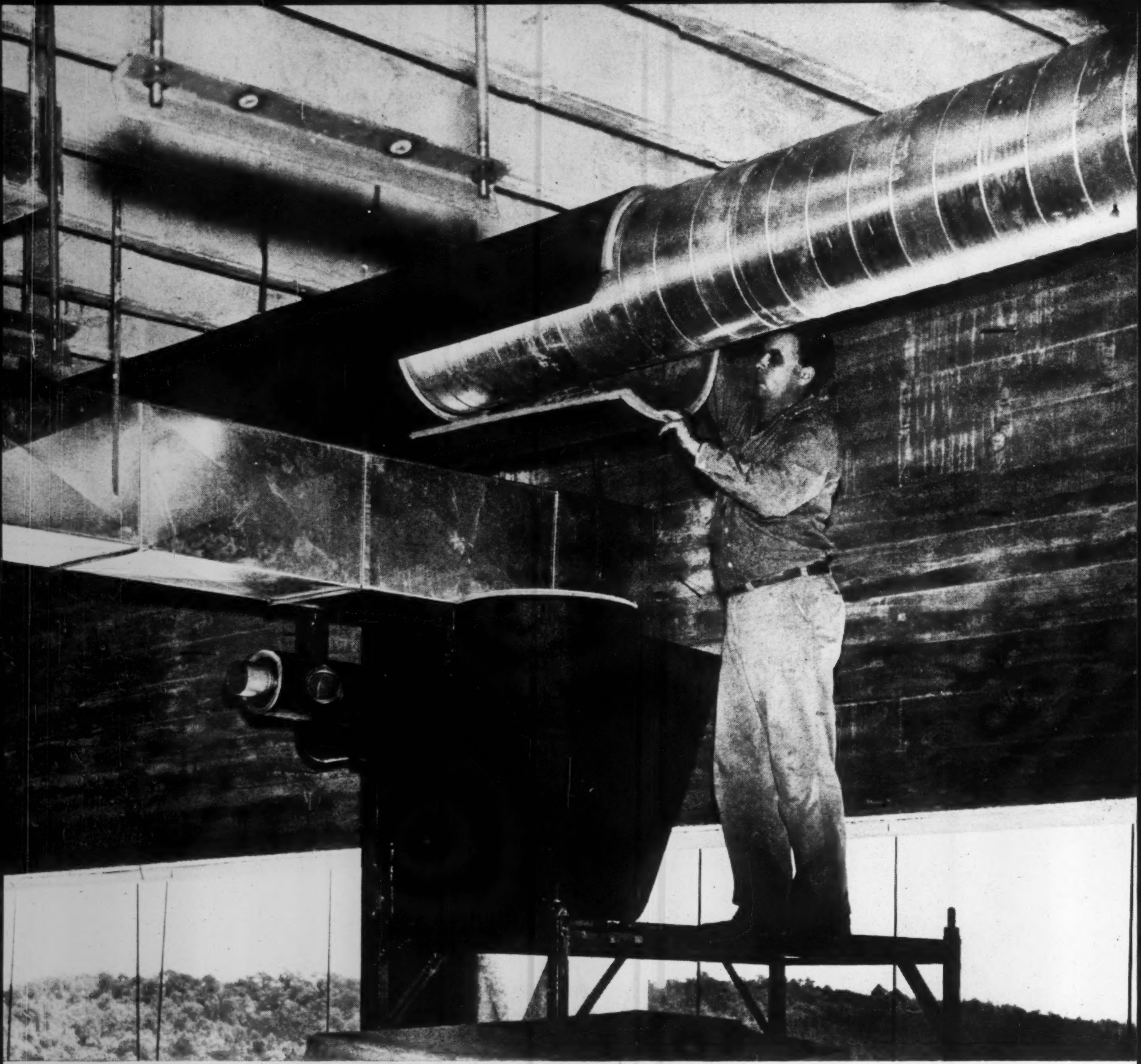
NEW YORK, LONG ISLAND CITY (6) 34-39 Thirty-first St.



New Idea!... G-B SNAP*ON® for high velocity duct systems

Snap!.... and 3 feet of duct is insulated, when you use G-B SNAP*ON, the one-piece insulation molded of fine glass fibers. Just spread the single seam . . . snap the 3 foot section over the duct . . . seal the vapor barrier seams . . . and that's *that.*

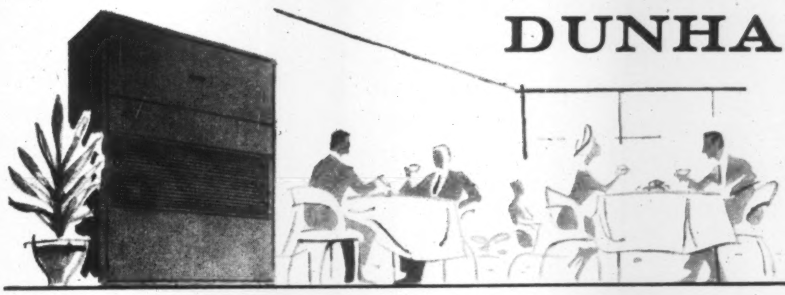
For many of the same reasons that have made G-B SNAP*ON the preferred pipe insulation, it is becoming increasingly popular for high velocity circular ducts. You can see at a glance how much time it saves. The finished job is neat in appearance and absolutely uniform in thickness—no bulges, no thin spots. Most important, G-B SNAP*ON's thermal efficiency is both outstanding and permanent, assuring economy of operation for the lifetime of the air conditioning system.

YOUR NEARBY G-B SNAP*ON DISTRIBUTOR IS LISTED IN THE YELLOW PAGES

GUSTIN-BACON *Manufacturing Co* GUSTIN gb BACON ®

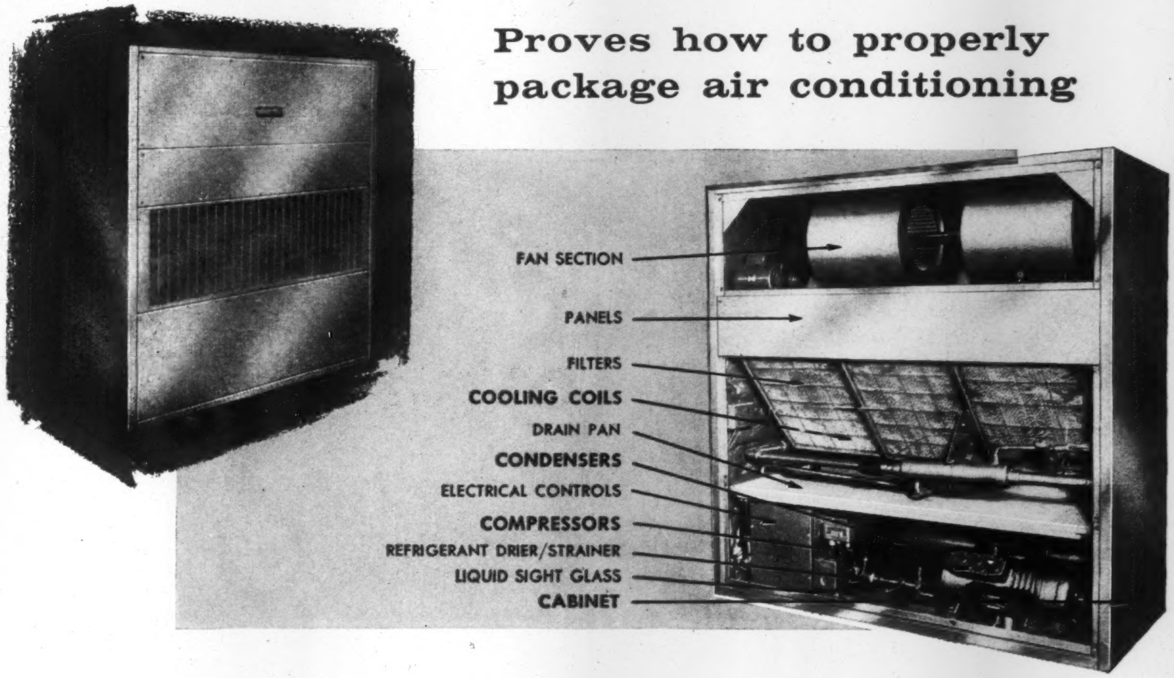
220 West 10th St., Kansas City, Mo.

Thermal and acoustical glass fiber insulations . . . Molded glass fiber pipe insulation
Couplings and fittings for plain and grooved end pipe



DUNHAM-BUSH 'PAC'

Proves how to properly package air conditioning



Important to contractors and specifiers is peak performance of Dunham-Bush "PAC" Packaged Air Conditioners, achieved through pre-engineered major components. Other manufacturers, using components from diverse sources, must attempt to improvise balance. But Dunham-Bush manufactures and designs the motor compressor, condenser, evaporative coils and cabinet specifically for "PAC". This "one source-one responsibility" is evident in dependable operation and customer satisfaction.

"PAC" units are packaged for use, on-premises or remotely installed, in restaurants, stores, offices, clubs, banks, factories, depots or wherever high capacity, self-contained air conditioning units are required. Attractive finish harmonizes with decor practically anywhere.

"PAC" is available in 10, 15, 20, 25 and 30 h.p. capacities.

You'll want to have full details. Write today for Bulletin No. 6022 or request a copy from your nearby Dunham-Bush representative.

Dunham-Bush, Inc.

WEST HARTFORD 10 • CONNECTICUT • U. S. A.

DUNHAM-BUSH

AIR CONDITIONING • REFRIGERATION • HEATING • HEAT TRANSFER

WEST HARTFORD, CONNECTICUT • MICHIGAN CITY, INDIANA
MARSHALLTOWN, IOWA • RIVERSIDE, CALIFORNIA

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DUNHAM-BUSH DUNHAM-BUSH, LTD. PORTSMOUTH, ENGLAND
BRUNNER BRUNNER CORPORATION (CANADA) LTD. PORT HOPE, ONTARIO

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Whatever the job . . . PERMACEL®

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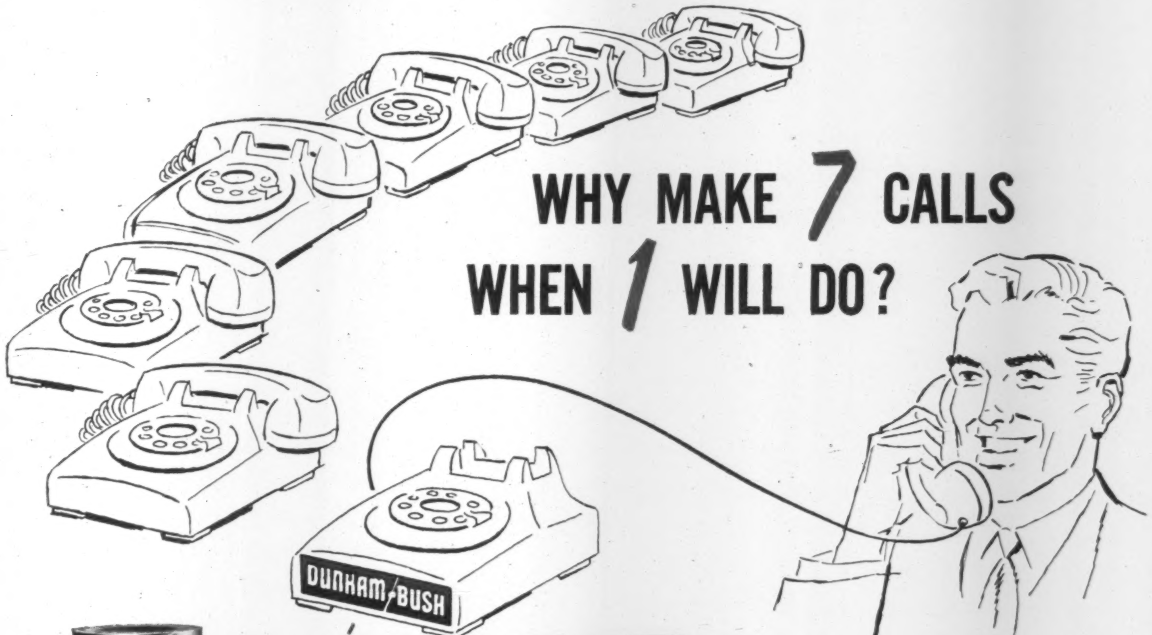
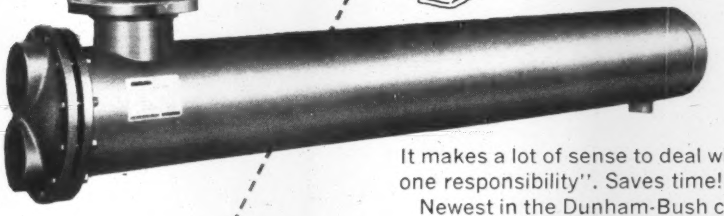
NEW BRUNSWICK, NEW JERSEY • TAPES • ELECTRICAL INSULATING MATERIALS • ADHESIVES

NEW DUNHAM-BUSH "SC" STEAM CONVERTER ELIMINATES "SHOPPING AROUND"!



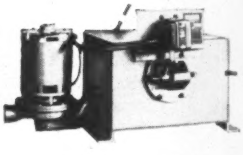


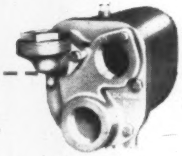
SAME PLACE YOU CALL FOR:

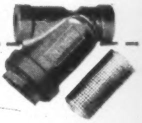
It makes a lot of sense to deal with Dunham-Bush and enjoy "one source-one responsibility". Saves time! Saves money! Adds dependability!

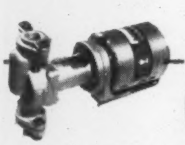
Newest in the Dunham-Bush complete line of components for the whole system is the "SC" Steam Converter. Used primarily for heating radiation water with steam, the Dunham-Bush "SC" Converter offers distinct application advantages. Piping design is simplified and design work is reduced. The "SC" is your best bet for providing heating water for office space in industrial buildings. When applied to high buildings, "SC" keeps static heads at reasonable levels as well as simplifying piping design.

Write today for complete details of the new Dunham-Bush "SC" Steam Converters. Request Form No. 1570.

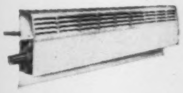

CONDENSATE PUMPS


F&T TRAPS


STRAINER


HOT WATER CIRCULATOR

DUNHAM
AIR SEPARATOR
AIR SEPARATOR


RADIATION

Plus a complete line of hot water heating specialties.

Dunham-Bush, Inc.

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DUNHAM-BUSH

AIR CONDITIONING • REFRIGERATION • HEATING • HEAT TRANSFER

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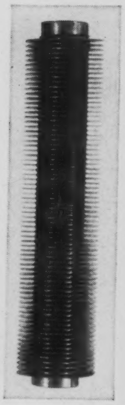
heat-x HEAT-X, INC. BREWSTER, N.Y.
DUNHAM-BUSH (CANADA), LTD. TORONTO, CANADA
DUNHAM-BUSH, LTD. PORTSMOUTH, ENGLAND
BRUNNER CORPORATION (CANADA) LTD. PORT HOPE, ONTARIO

NEW LOW SILHOUETTE **FANDAIRE** AIR-COOLED CONDENSERS

ALWAYS FACED RIGHT —NO MATTER WHAT THE WIND DIRECTION

No need to position circular Fandaire Air-Cooled Condensers to meet prevailing winds. Just set it anywhere for easiest piping.



Exclusive Aimco fintube design provides high-heat dissipating efficiency for circular Fandaire condensers.

Here's the newest, most advanced air-cooled condenser on the market—Fandaire! This modern low silhouette condenser is engineered around a new high-heat dissipating fintube of exclusive design and manufacture. In operation, the entire spiral of fintubing is surrounded with a circle of swiftly moving cool air for highest cooling efficiency. Every degree in temperature drop is fully utilized as this circular design captures the wind from *any* direction, regardless of placement or location. A powerful fan pulls cool air in and pushes warm used air up and away. Fandaire's constant gravity tube drainage gives continuous movement to condensate.

With its low, clean-lined silhouette, Fandaire does not detract from the general architectural effect of the building. And weighing ⅓ less than conventional installations, the Fandaire usually can be positioned where needed, without guy wires or extra bracing. Savings in piping and installation alone may be considerable.

Where there is a problem of architectural compatibility, or of cost or performance, chances are the new Fandaire Air-Cooled Condenser is the best solution. Engineered in sizes from 3 to 120 tons per unit, there is a Fandaire model for practically all single or multiple installations. Get complete information today.

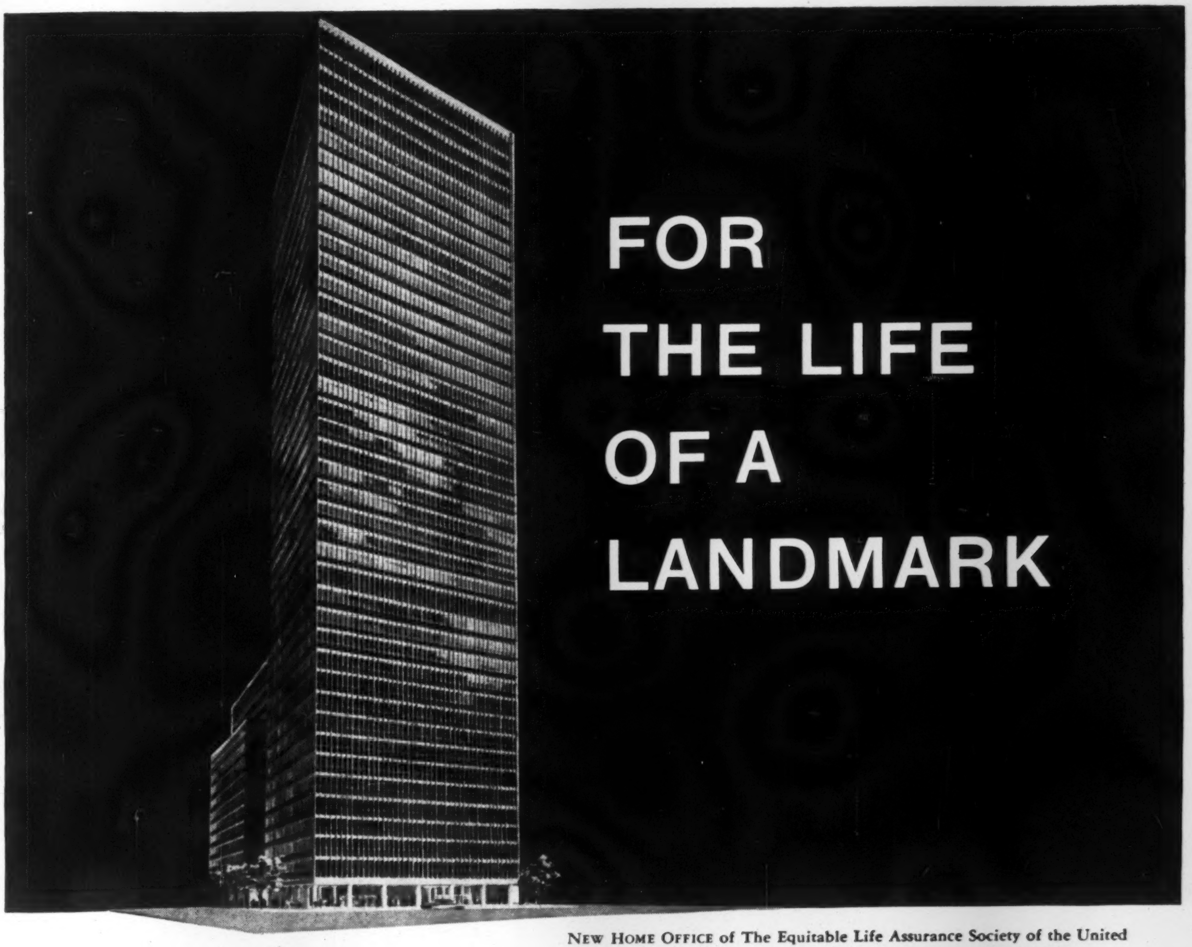
specialists in circular air-cooled condensers

YUBA

YUBA-AIMCO DIVISION
801 West 21st Street, Tulsa, Oklahoma

YUBA CONSOLIDATED INDUSTRIES, INC.

Sales Offices in Atlanta • Buffalo • Chicago • Cleveland • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Seattle



NEW HOME OFFICE of The Equitable Life Assurance Society of the United States. *Skidmore, Owings & Merrill*, Architects. *Turner Construction Company*, General Contractor. *Eugene Duklauer, Inc.*, Plumbing Contractor.

Money Saved... with every foot of galvanized steel pipe installed in New York's new Equitable Life Building

There's a new landmark going up on The Avenue of The Americas. By completion next year, 150 tons of steel pipe will have been installed by Eugene Duklauer, Inc., the plumbing contractor.

Steel Pipe was specified for waste lines and vents. It is perfectly dependable in these applications. And Steel Pipe costs less installed.

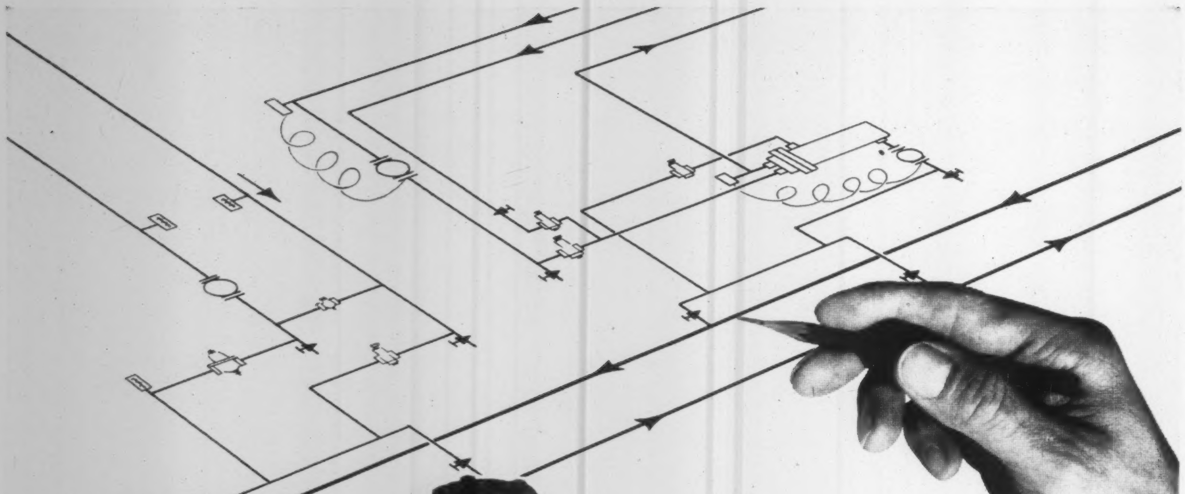
For clean, rust-free, rust-resistant pipe, call your Republic distributor. This man delivers pipe as you need it on the job. He delivers pipe that is easier to cut, easier to thread, and easier to bend.

Get in touch with him today. Or, write Republic Steel Corporation, Dept. HP-1045, 1441 Republic Building, Cleveland 1, Ohio.

INSIST ON PIPE MADE IN U.S.A.

CALL YOUR LOCAL DISTRIBUTOR FOR QUICK DELIVERIES OF

REPUBLIC *Steel Pipe*



B&G Universal Pumps circulating primary mains.

B&G Booster Pumps supplying individual heating zones.

Primary and secondary pumping as developed by B&G® cuts heating system operating costs

Where multiple buildings or multiple zones within a building are to be heated with circulated water, *Primary and Secondary Pumping*, as conceived and developed by Bell & Gossett engineers, both reduces pump horsepower and saves fuel by improving heat control.

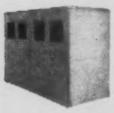
A typical system consists of a primary main continuously circulated by a B&G Universal Pump, with smaller B&G Booster Pumps drawing on the main to supply separate heating zones. Each zone pump is under individual thermostat control, so that each zone can be supplied with exactly the amount of heat required by its function or exposure.

Write for free booklet which gives detailed information on this more efficient, more economical method of heating with circulated water.

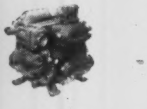
BELL & GOSSETT COMPANY
Dept. GJ-5, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong, Ltd.,
1400 O'Connor Drive, Toronto 16, Ontario

A DIVERSIFIED LINE OF HIGHEST QUALITY PRODUCTS

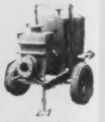
Booster Pumps



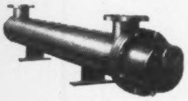
Package Liquid Coolers



Refrigeration Compressors



Marlow Pumps



Heat Exchangers

Oil-less Air Compressors

THE NEW, TIGHT-CLOSING PRESSURE REDUCING VALVE THAT *CAN'T FOUL*

If you like a simple, straight-forward solution to vexing valve problems, you're bound to be impressed with the new line of Leslie-Topper Pressure Reducing Valves. To avoid valve fouling, Leslie Engineers developed a tight-closing valve with an internal pilot that's completely out of the path of steam—*it just can't foul*. Let imaginative engineering simplify valve design and you get results.

Here's the one pressure reducing valve that handles poor steam conditions, intermittent or standby service better than any other valve. It provides high accuracy of regulation with negligible dead-end build up and costs only pennies for maintenance.

New, patented Leslie-Spiroflex* all metal diaphragm insures years of outstanding valve performance. It makes a long valve stroke possible in a packless design—there's nothing to leak, nothing to bind. It's time for a change when you can get rid of the cost and bother of fussy, old-fashioned pressure regulators.

*Trademark of Leslie Co.

Leslie-Topper Selection Table

Size	Inlet Pressure PSI	Adjustable Pressure Range PSI	CLASS		
			Cast Iron Construction	Bronze Body Construction With Iron Superstructure Castings*	All Bronze Construction
½" TO 1¼"	UP TO 150	2 - 10	GKLL	GLL	GBLL
	OVER 125	2 - 10	GKL	GL	GBL
	UP TO MAXIMUM BODY RATING	5 - 20	GKM	GM	GBM
		15 - 35	GKH	GH	GBH
1½" TO 2"		2 - 10	GKL	GL	GBL
		5 - 20	GKM	GM	GBM
	UP TO 150	5 - 35	GKHL	GHL	GBHL

*All parts in contact with controlled fluid are of bronze.

For sizing and capacity data write for Bulletin 582 or contact your Leslie Engineer—he's listed in the Yellow Pages under 'Valves' or 'Regulators'.

Leslie Co., 703E Grant Ave., Lyndhurst, New Jersey

LESLIE TOPPER
REDUCING VALVE
CLASS G
RANGE 2-10
FOR INLET PRESSURE
TO 300 PSI
FOR SERIAL NO. SEE
DIAPHRAGM FLANGE
PATENT NO. 2855002
1
LESLIE

This new Leslie-Topper Pressure Reducing valve is a part of Leslie's expanding line of control valves, regulators and pilots for steam, air and liquids.

TRADE
LESLIE
MARK

REGULATORS and CONTROLLERS

ABOVE ALL
Catch-All FILTER DRIER
SPORLAN VALVE CO.

SPORLAN

Catch-All *See•All*

PEAK PERFORMANCE PARTNERS...
with all these "first" features

- The desiccant is formed into a molded porous core.
- It cannot powder.
- It cannot pack.
- The refrigerant cannot channel around the desiccant.
- It provides full line flow protection in every size.
- Filtering instead of straining.
- Corrosive acids are adsorbed and retained within the core itself.
- Maximum drying thru highest degree of activation.
- Moisture and tamper proof sealed fittings.

Write for Bulletin 70-10 on the Sporlan See•All and Bulletin 40-10 on Sporlan Catch-Alls!

- One indicator for Refrigerants 12-22-40 & 500. Green always means dry. Chartreuse is the caution signal, and when the indicator turns to Yellow, the system is too wet!
- Color changes are easily distinguished and reversible.
- An indicator protected from dirt by a filter pad.
- Color change point that is reliable and accurately calibrated to temperature.
- Can be installed anywhere in the liquid line.
- A full-view sight glass — large viewing area.
- Double gasket — each a molded wedge providing a positive leakproof joint.
- Connections — flare, swivel nut or sweat.
- Disassembly not required during installation of sweat connection types.

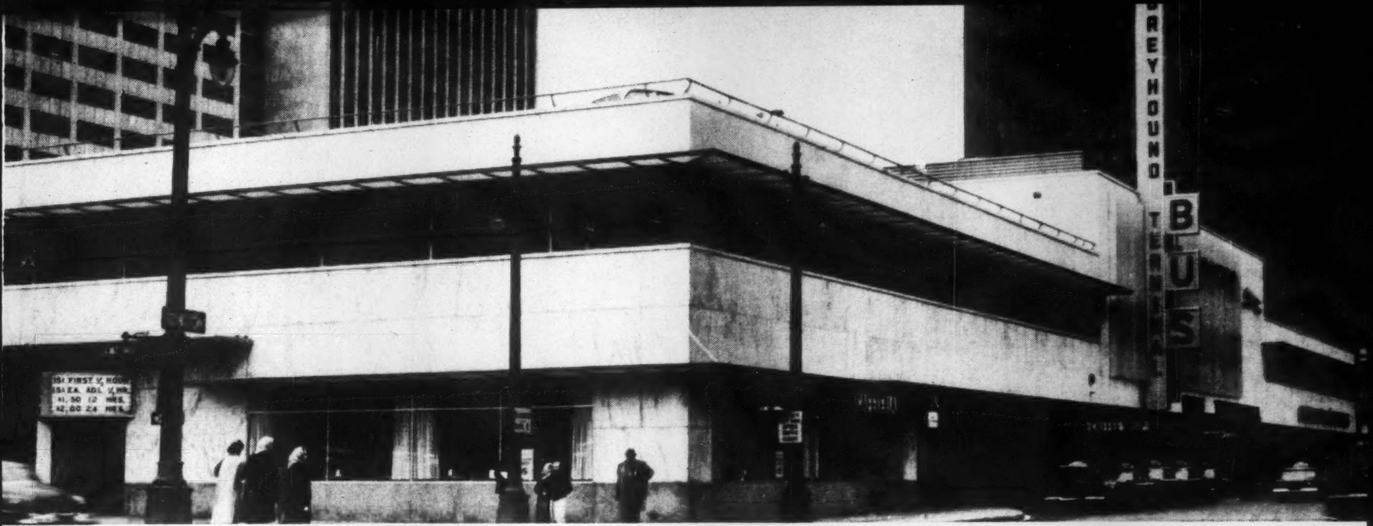
SPORLAN See·All
SPORLAN Catch-All

See your friendly Sporlan Wholesaler and ask him about these two Peak Performance Partners!

By-pass kits available for economical installations on large liquid lines!

SPORLAN VALVE COMPANY
7525 SUSSEX AVENUE ST. LOUIS 17, MISSOURI

EXPORT DEPT. 85 BROAD STREET NEW YORK 4, N. Y.



Spang Steel Pipe provides all piping services in Detroit's new $4,500,000 Greyhound Bus Terminal.

SPANG® Steel Pipe uniformity pays off in Greyhound Terminal Installation

All the steam heating, air conditioning, plumbing, natural gas and storm drainage facilities in Detroit's new Greyhound Bus Terminal Building are serviced by SPANG Steel Pipe in sizes ranging from ¾″ to 8″. SPANG offered many advantages during installation. Listen to what Vice President George H. Whybrew of James & Roach, mechanical contractors, said about it.

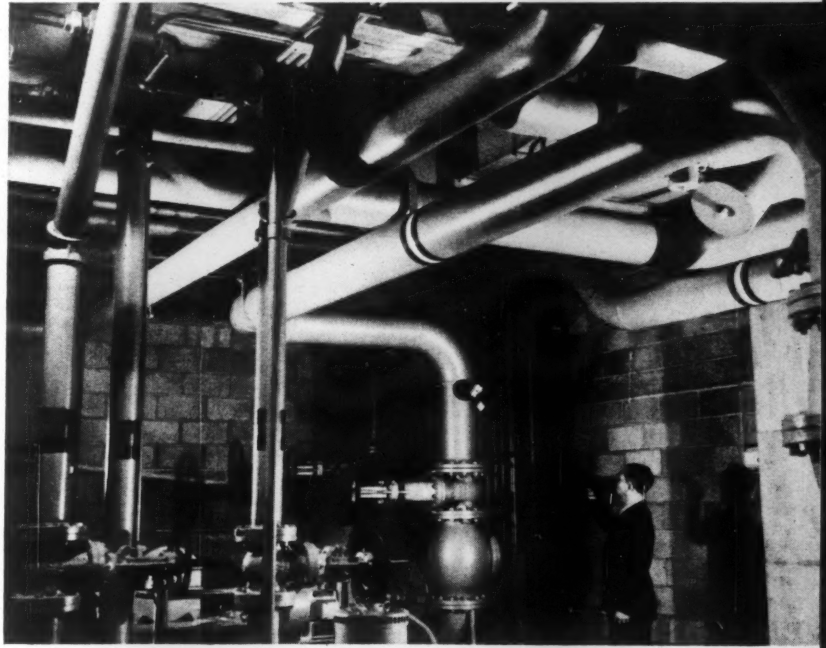
REPORT FROM MECHANICAL CONTRACTOR

"We had excellent delivery service on SPANG, getting what we needed when we needed it with no delay. And we got a good product. Our pipe had been hydrostatically tested at pressures many times our highest requirements.

"On actual installation, the consistent uniformity of SPANG Pipe was important in saving us time. We had some severe bends to do, but the pipe held up beautifully—no kinking, flaking or cracking. End cuts and bevels were true, and welding was no problem. In exposed locations, the smooth exterior finish painted nicely and made a good appearance. Yes, I'd recommend SPANG without hesitation on the basis of this job alone!"

GET DEPENDABLE PERFORMANCE WITH SPANG

Mr. Whybrew is just one of many contractors who know they can count on SPANG's uniformity for top-quality installations. SPANG can help you, too. Next job, be sure to ask for SPANG Steel Pipe . . . made in U.S.A. Call your nearby SPANG Distributor for service.



Steel

Steel's Symbol of strength, long life, and economy

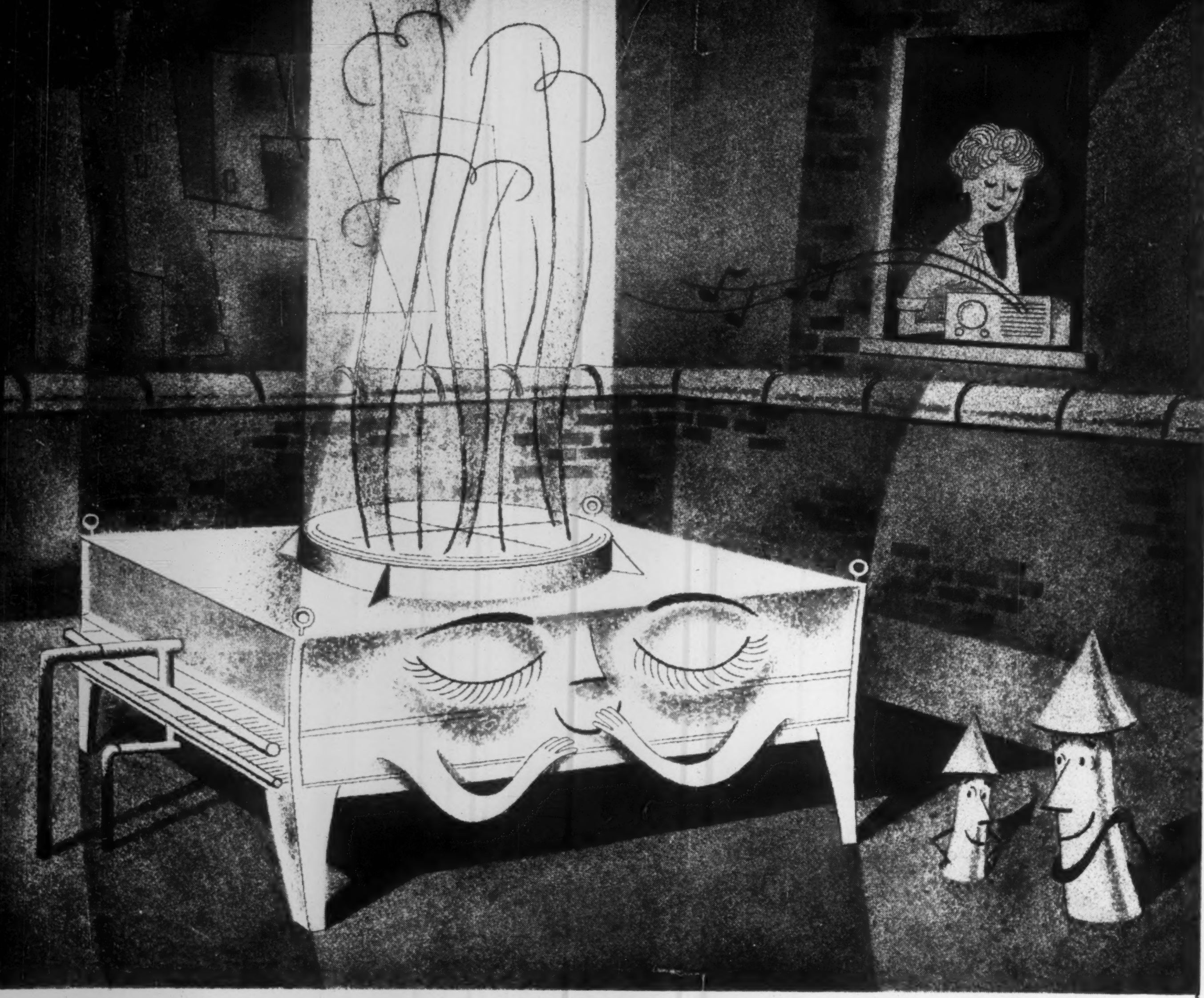
In exposed locations, Spang's smooth exterior provides neat appearance. Spang Pipe uniformity and good service helped speed this job's construction.

SPANG CW STEEL PIPE

THE NATIONAL SUPPLY COMPANY

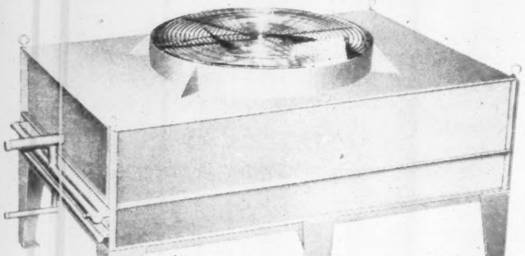
Two Gateway Center, Pittsburgh 22, Pennsylvania
Subsidiary of Armco Steel Corporation ARMCO®

Owner: Eastern Greyhound Lines, Division of the Greyhound Corporation, Cleveland, Ohio
Architect: Arrasmith and Tyler, Louisville, Kentucky
General Contractor: Bryant and Detwiler, Detroit 26, Michigan
Mechanical Contractor: James & Roach, Detroit, Michigan
Engineer: Southern Engineering Corporation, Louisville, Ky.
Spang Distributor: O'Connell Supply Company, Dearborn Mic



Ever hear of a bashful air-cooled condenser?

Check the new Halstead & Mitchell vertical air flow condenser



ACV SERIES —
5 TO 100 TONS

H&M's new ACV Air-Cooled Condenser with vertical air flow hates to be showy. It's so low and so quiet, you hardly know it's there—very appealing to owners, their neighbors, architects and engineers!

Roof loading is low, too, and air flow noise is directed away from surrounding structures. This delights building owners and tenants alike.

Vertical air flow models are available in 5 to 100 tons. And like all H&M Air-Cooled Condensers, the ACV series features exclusive Turbu-Flo fins, spaced wide to prevent clogging by air-borne dirt. Multiple circuiting is available for your specific needs *at no extra cost.*

Get the whole story on H&M Air-Cooled Condensers—with propeller or centrifugal fan. Ask your refrigeration wholesaler for a copy of the new bulletin AC-102. Or write to Halstead & Mitchell, Bessemer Bldg., Pittsburgh 22, Pa.

HM

Halstead & Mitchell

Air-Cooled Condensers • Finned Coil Products • Water-Cooled Condensers • Cooling Towers

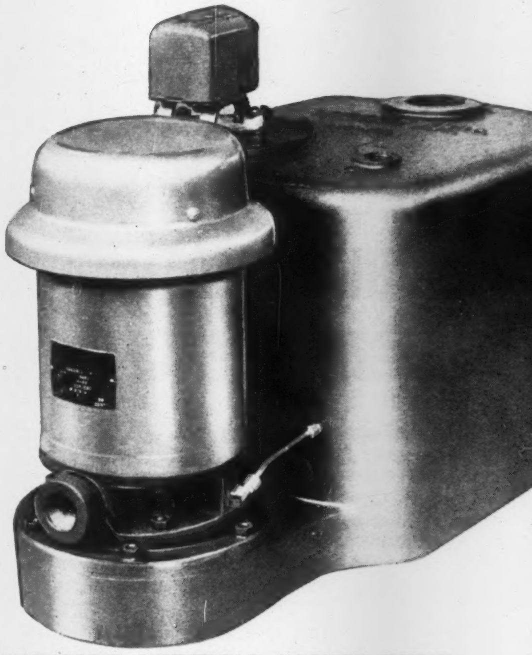
Mechanical Shaft-Seal

close-coupled design

Specify SKIDMORE

More Capacity!

More Performance!



SKIDMORE VERTICAL "CCVS" PUMP

RIGHT DOWN THE LINE . . .

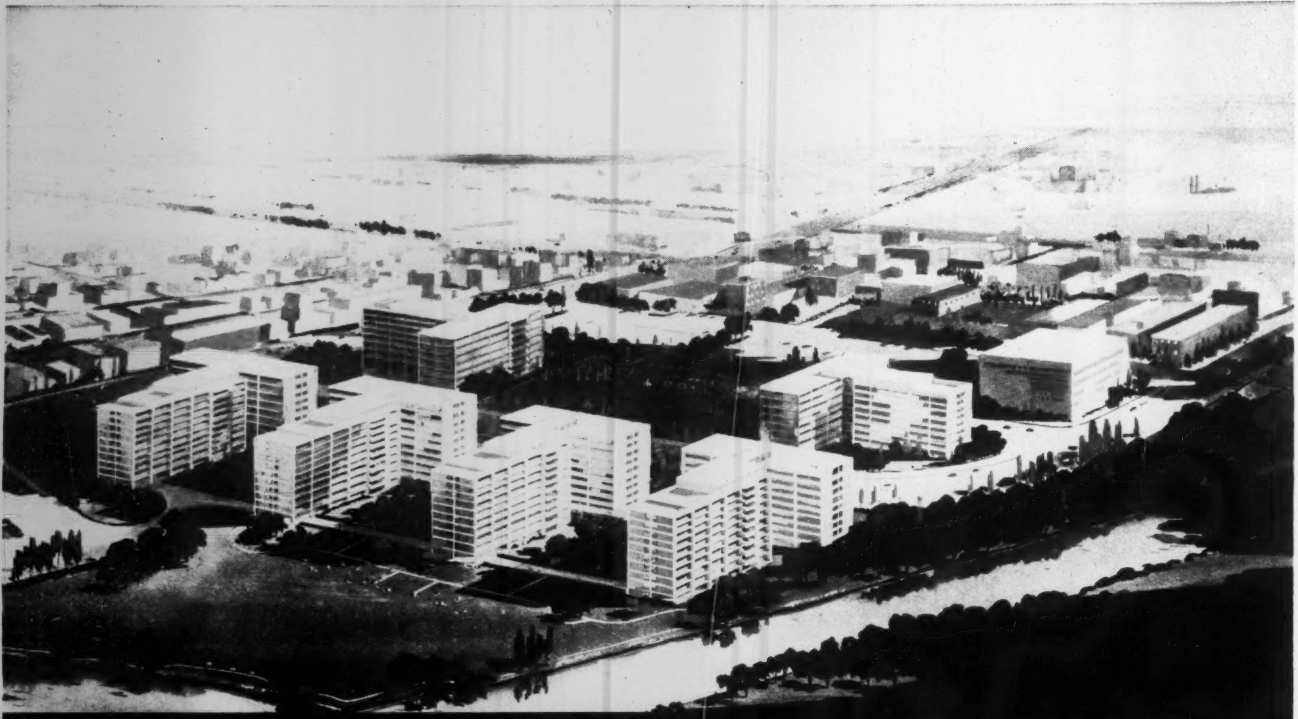
Whatever the application . . . wherever you need a dependable heating pump . . . one thing is sure . . . Skidmore advanced design engineering has produced pumps of simple, rugged construction to give you year around, economical, maintenance-free service. See your Skidmore Representative today for complete information.

Skidmore Pumps have set a standard of performance and dependability—through continual research and development since 1921

SKIDMORE CORPORATION

ST. JOSEPH, MICH.

Choose with Confidence!



Architect's rendering of Alfred Speer Village, Public Housing Project at Passaic, N. J. Sarcotherm Heating Control Systems are used in this as well as in the Authority's Vreeland Village. Kelly & Gruzen were architects and engineers for both projects.

"THIS HOUSING PROJECT'S SARCOTHERM VACUUM HEATING CONTROL SYSTEM HAS BEEN EXCELLENT IN ALL RESPECTS...

Behind this report of complete satisfaction from the Passaic, New Jersey, Housing Authority are the basic reasons why it pays to install a Sarcotherm Outdoor Controlled Weather-Compensating System. These systems not only provide the precise temperature control so critical in housing projects, but are easy to install and operate, and never waste fuel. Sarcotherm's advantages cost no more, and the inherently simple design of the system keeps maintenance costs to a minimum.

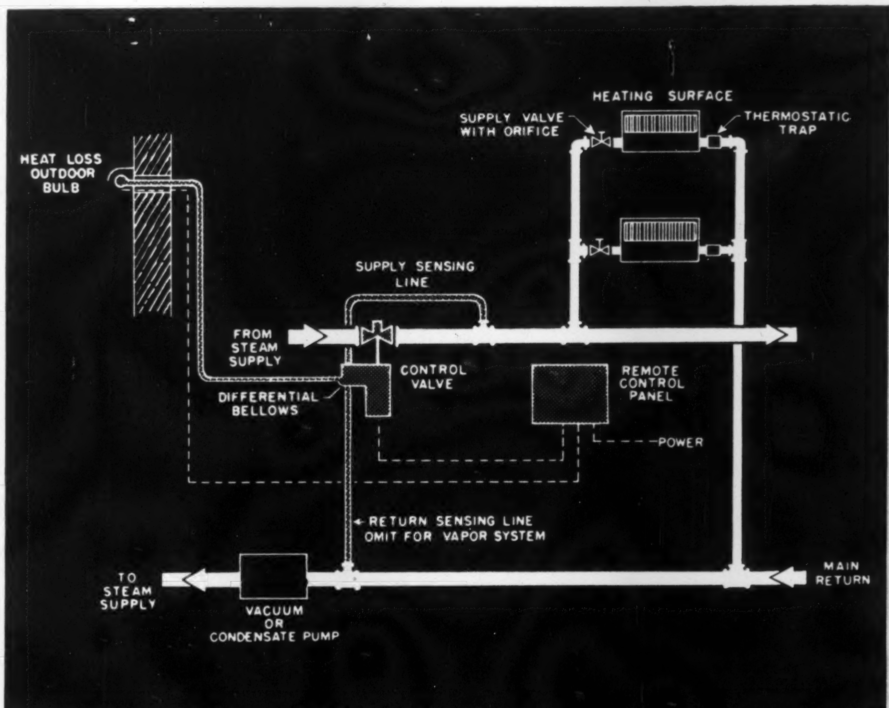
This project involved two installations, Alfred Speer Village, heated by steam, and Vreeland Village, heated by hot water. Both were directed by the Passaic Housing Authority and designed by Kelly and Gruzen Architects and Engineers. Sarcotherm engineers cooperated with their architects, engineers and contractors to achieve best results.

On projects like this, Sarcotherm saves time, effort and money. A minimum of wiring is required which makes for simpler, faster hook-ups. In operation, a Sarcotherm system cuts fuel costs through precise metering of delivered heat, yet an exact degree of comfort is provided regardless of outside temperatures. Operating personnel can easily make adjustments to maintain accurate specified temperature levels.

All Sarcotherm components are built to the highest standards in the industry for long-lived reliability. In addition, a Sarcotherm contract brings you the advantages of single-source responsibility: you get your complete control system as well as heating specialties and accessories from a single centralized supplier. Write for Sarcotherm Control Catalog. Specify steam or hot water.

SARCOTHERM

SARCOTHERM CONTROLS, INC.,
AN AFFILIATE OF SARCO COMPANY, INC.,
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.


HEATING SURFACE
SUPPLY VALVE WITH ORIFICE
THERMOSTATIC TRAP
HEAT LOSS OUTDOOR BULB
SUPPLY SENSING LINE
FROM STEAM SUPPLY
CONTROL VALVE
REMOTE CONTROL PANEL
DIFFERENTIAL BELLOWS
POWER
RETURN SENSING LINE OMIT FOR VAPOR SYSTEM
TO STEAM SUPPLY
VACUUM OR CONDENSATE PUMP
MAIN RETURN

Schematic hook-up of typical Sarcotherm Steam Heating Control System at Alfred Speer Village apartments, Passaic, N. J. Vreeland Village utilized Sarcotherm hot water controls.

Here are just a few of the many other

PUBLIC HOUSING PROJECTS using SARCOTHERM WEATHER-COMPENSATING HEATING CONTROL SYSTEMS

Name	Number of Zones	Installed
Marvine Village Bethlehem, Pa.	82	1952
Cherry Hills Baltimore, Md.	53	1956
Hanover Acres Allentown, Pa.	35	1939
Beardsley Terrace Bridgeport, Conn.	16	1953
Fayette County Housing Fayette Co., Pa.	15	1951
Rome Housing Rome, N. Y.	8	1952
Norwalk Project No. 1 Norwalk, Conn.	8	1950
Norwalk Project No. 2 Norwalk, Conn.	2	1952
Commodore Perry Buffalo, N. Y.	6	1956
Scranton Housing Scranton, Pa.	6	1953
Pequonnock Housing Bridgeport, Conn.	4	1954
Long Branch Housing Long Branch, N. J.	3	1958
Waterbury Housing Waterbury, Conn.	3	1953
Port Chester Project No. 1 Port Chester, N. Y.	2	1949
Port Chester Project No. 2 Port Chester, N. Y.	2	1951

. . . AND THERE'S BEEN MINIMUM MAINTENANCE," SAYS THE PROJECT ENGINEER . . . AFTER 7 YEARS OF TROUBLE-FREE OPERATION

Year-in, year-out heating comfort for these housing projects is only part of the story. Maintenance of the Sarcotherm Heating Control System is another, and the Passaic, New Jersey Housing Authority says that only a minimum of service has been required. Reason: Fewer parts and simplified wiring.

Sarcotherm plans for your heating system's future from the very beginning. For example, Sarcotherm always unit packs and tags every component, prepares complete working drawings, and keys all parts to the drawings. Trained Sarcotherm personnel contribute to the speed and efficiency of the work on the job, make final adjustments, and take the system through start up. Sarcotherm provides complete operating manuals and instructs the people who will operate the system. This not only reduces installation time, but sets the stage for trouble-free operation in years to come.

All projects like those described here can benefit from Sarcotherm's more than half century of specialized experience in steam and hot water systems. Get more information about Sarcotherm on-the-job cooperation, and how it contributes to the speed and efficiency of installation and initial adjustment. Write for your copy of the Complete Control System Catalog. Specify Steam or Hot Water.

FOR COMPLETE CONTROL SYSTEM CATALOG write Sarcotherm Controls, Inc., 635 Madison Avenue, New York 22, N. Y.

SARCOTHERM

SARCOTHERM CONTROLS, INC.,
AN AFFILIATE OF SARCO COMPANY, INC.,
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

5-WAY MONEY SAVER

SONOCO
SONOAIRDUCT®
FIBRE DUCT

Sonoco SONOAIRDUCT – the *original* (and still best-selling) Fibre Duct for slab perimeter heating and cooling – saves contractors and owners money five ways!

1. Low initial cost.
2. Cuts installation costs. Lightweight SONOAIRDUCT handles, joins, levels easily, and long lengths mean fewer joints. Can be cut to size with a hand saw.
3. Every piece is usable. SONOAIRDUCT won't chip, crack or break when dropped – no sharp edges either!
4. Job-proven performance dependability . . . protects your reputation and your customer's pocketbook. Meets or exceeds all F.H.A. criteria and test requirements for products in this category.
5. Low operating costs. SONOAIRDUCT'S aluminum foil lining offers a low coefficient of air friction and low heat loss ratio.

Use economical, time-saving Sonoco SONOAIRDUCT Fibre Duct on your next slab perimeter job. Order required lengths or standard 18′ lengths – in 23 sizes from 2″ to 36″ I.D.

FREE INSTALLATION MANUAL

contains latest, detailed, step-by-step installation data for SONOAIRDUCT Fibre Duct. For free copy, send us your name and address on company letterhead.

SONOCO
SONOAIRDUCT
FIBRE DUCT
INSTALLATION INSTRUCTIONS
FOR PERIMETER HEATING AND COOLING SYSTEMS
PERIMETER SYSTEMS

For complete information and prices, write

SONOCO

Construction Products

SONOCO PRODUCTS COMPANY, HARTSVILLE, S. C. • La Puente, Calif. • Fremont, Calif. • Montclair, N. J. • Akron, Indiana • Longview, Texas • Atlanta, Ga. • Brantford, Ont. • Mexico, D. F.

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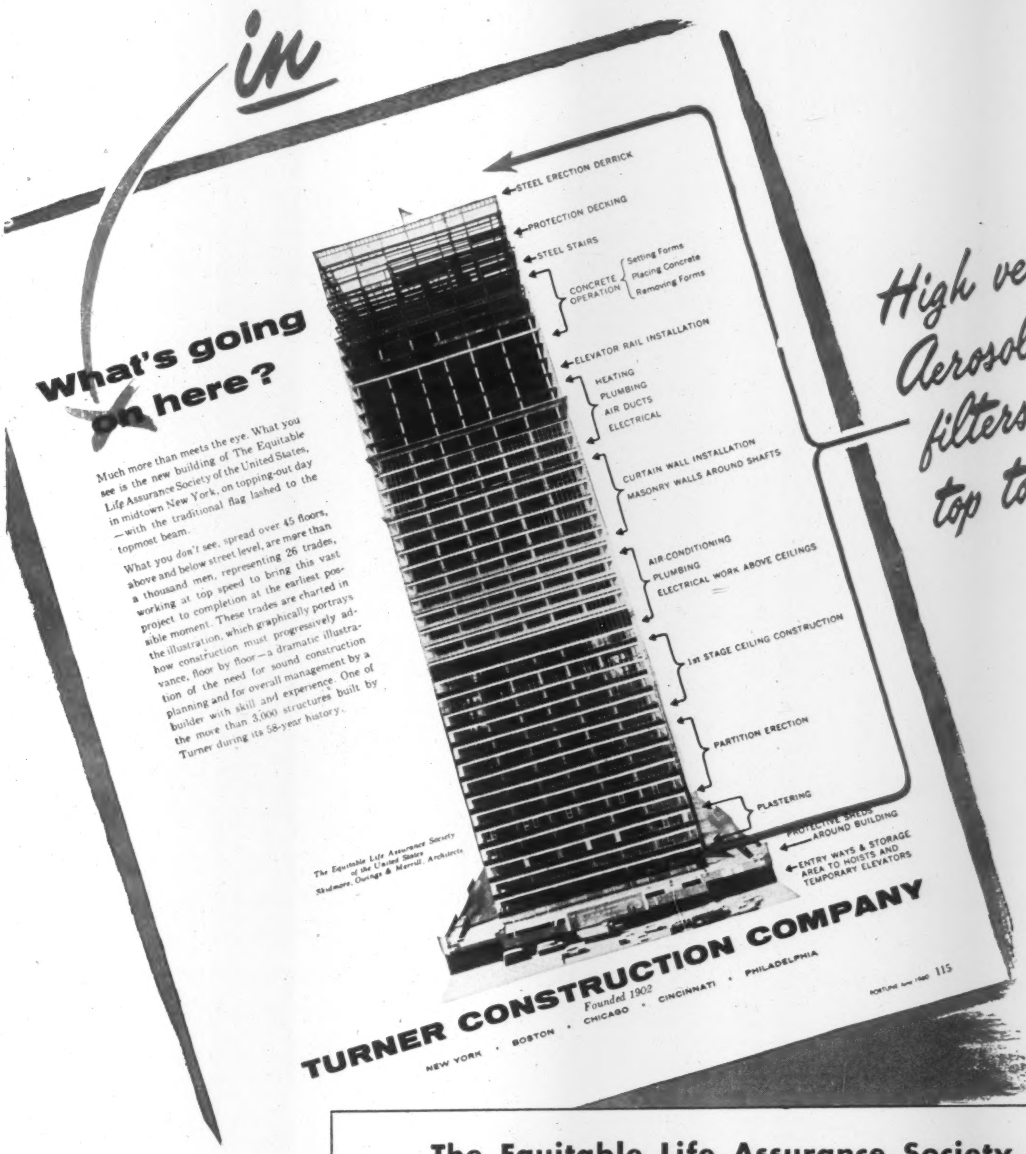

in
STEEL ERECTION DERRICK
PROTECTION DECKING
STEEL STAIRS
CONCRETE OPERATION
Setting Forms
Placing Concrete
Removing Forms
ELEVATOR RAIL INSTALLATION
HEATING
PLUMBING
AIR DUCTS
ELECTRICAL
CURTAIN WALL INSTALLATION
MASONRY WALLS AROUND SHAFTS
AIR CONDITIONING
PLUMBING
ELECTRICAL WORK ABOVE CEILINGS
1st STAGE CEILING CONSTRUCTION
PARTITION ERECTION
PLASTERING
PROTECTIVE SHEDS AROUND BUILDING
ENTRY WAYS & STORAGE AREA TO HOISTS AND TEMPORARY ELEVATORS

What's going on here?

Much more than meets the eye. What you see is the new building of The Equitable Life Assurance Society of the United States, in midtown New York, on topping-out day —with the traditional flag lashed to the topmost beam.

What you *don't* see, spread over 45 floors, above and below street level, are more than a thousand men, representing 26 trades, working at top speed to bring this vast project to completion at the earliest possible moment. These trades are charted in the illustration, which graphically portrays how construction must progressively advance, floor by floor—a dramatic illustration of the need for sound construction planning and for overall management by a builder with skill and experience. One of the more than 3,000 structures built by Turner during its 58-year history.

The Equitable Life Assurance Society of the United States
Skidmore, Owings & Merrill, Architects

TURNER CONSTRUCTION COMPANY
Founded 1902
NEW YORK · BOSTON · CHICAGO · CINCINNATI · PHILADELPHIA

FORTUNE June 1960 115

High velocity Aerosolve® 95 filters from top to bottom

The Equitable Life Assurance Society of the United States

Skidmore, Owings & Merrill
Architects

Meyer, Strong & Jones
Mechanical Engineers

Turner Construction Company
General Contractor

Kerby Saunders, Inc.
Mechanical Contractor

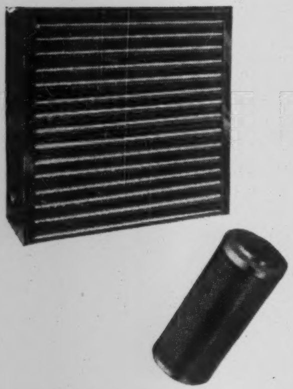
We thank Turner Construction Company for permission to use their advertisement as a report on this significant project and for their skill in scheduling the smooth delivery of the Cambridge AEROSOLVE Filters which will keep 1,300,000 c.f.m. of air really clean throughout the building.

Cambridge Filter Corporation

732 East Erie Boulevard, Syracuse 1, New York

HOW DOREX AIR RECOVERY annually cuts air conditioning costs by 78%

Over a 20-year period, the dollar difference is incredible, the penalties of owning and operating cost are tremendously reduced . . . if an air conditioning system uses DOREX to recover already conditioned air rather than use 100% outside air.



DOREX is designed in two basic types—C Cells and H Canisters. Because of their arrangement flexibility, canisters are especially suitable where installation space is limited or irregular.

ESTIMATED DIFFERENTIAL OF OWNING AND OPERATING COSTS, OUTDOOR AIR vs RECOVERY AIR FOR 1000 CFM

ITEM	ANNUAL FIXED CHARGES	OUTDOOR AIR	RECOVERY AIR
1.	Amortization, 20 years, cost per year	$ 78.10	$ 17.50
2.	Interest rate, 4 percent [(20 yr + 1)/(2 × 20 yr)] × 0.04 × initial cost	32.00	7.35
3.	Taxes and insurance (neglected)	0.00	0.00
4.	Total annual fixed charges	110.10	24.85
	ANNUAL MAINTENANCE COSTS		
5.	Repairs, refrigerating equipment $1.20 per ton	4.56	
6.	Refrigerant 0.44 per ton	1.67	
7.	Oil and grease 0.12 per ton	0.46	
8.	Repairs, heating gross	5.00	
		11.69	
	ANNUAL SERVICE COSTS		
9.	Electric power, refrigeration (0.746 × hp × cooling hours)e* = 3220 kwhr		
10.	Cost of electric power 1.5¢ per kwhr		
11.	Refrigeration power costs (Items 9 and 10)	48.20	
12.	Water at 11 cents per 1000 gal (neglected with cooling tower)		
13.	Heat requirement 4.5 × 1000 × 11.7** × 2200/e* = 165,000MBtu		
14.	Gas cost, $1.00 million Btu		
15.	Heating cost (Items 13 and 14)	165.00	
16.	Recovery fan power, 0.0001573 × 1000 head = 0.063 hp		
17.	Recovery fan power, [0.746(16) (2200 + 810)]/e = 188 kwhr		
18.	Recovery fan power costs (Items 10 and 17)		2.82
19.	Labor to change recovery cells		2.00
20.	Freight to ship used and recharged units		10.00
21.	Regenerate, recover cells		35.00
		213.20	49.82
	SUMMARY		
	Annual fixed charges	110.10	24.85
	Annual maintenance costs	11.69	
	Annual service costs	213.20	49.82
	Total annual owning and operating costs	334.00	74.67
	Annual savings with air recovery		260.32
		334.99	334.99

*Efficiencies are taken in items 9 and 13 as 70 and 75 percent respectively.
**Difference in enthalpy, Btu per lb of dry air, between inside and outside, for average winter conditions.
From a paper by Warren Viessman, Heating, Piping & Air Conditioning—Sept. 1959

By recovering used, already conditioned air, extracting from it the accumulated impurities, and converting it to original freshness, DOREX brings about maximum economy in air conditioning. Detailed information on the unique DOREX process and equipment is available. Simply request—on your letterhead, please—Bulletin 108A and "Air Conservation Engineering". Contact the representative near you or write to Connor direct.

CONNOR ENGINEERING CORPORATION
DANBURY • CONNECTICUT

CONNOR
ENGINEERING CORPORATION
dorex®
air recovery

. . . the most experienced professionals in air recovery and purification.

Protect profits from call-back expense . . . insulate hot and cold water lines with

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- Internal oxidation and deterioration are prevented by millions of inert gas cells.
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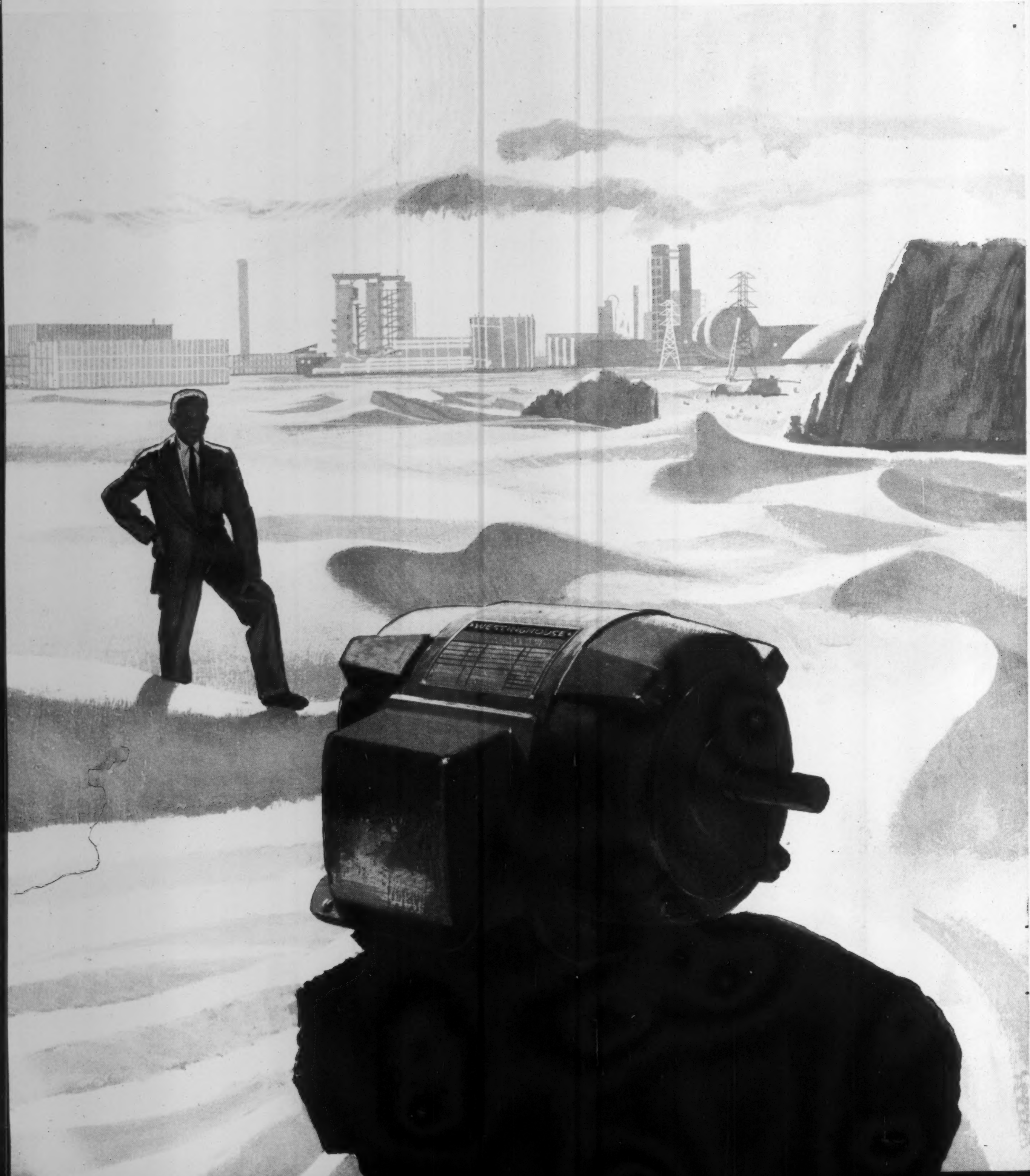
NEW WESTINGHOUSE *Guardistor*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The man and the motors from Westinghouse now provide absolute protection against motor failure caused by excessive heat . . .

Our Engineering Manager says:
"With the breakthrough development of the Westinghouse Positive Temperature Coefficient thermistors, for the first time we can provide inherent protection against motor failure caused by excessive heat. The solid-state thermistors buried in the windings instantly sense excessive heat from any cause and simultaneously warn of trouble or automatically take the motor off the line. Thus, motor protection is placed where only true motor protection can be . . . in the windings."

Our Marketing Manager says:

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- Provides positive protection based on winding temperature . . . *not* load current and/or power supply fluctuations.
- Eliminates time and expense of changing winter-summer heaters. No nuisance tripping, it's fail-safe . . ."

Call your Mr. Westinghouse for the application of a Guardistor* motor to your drive requirements . . . write for *Questions and Answers About . . . Guardistor* (B-7876). Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. You can be sure . . . if it's Westinghouse.

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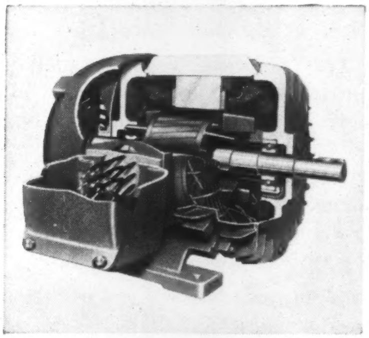
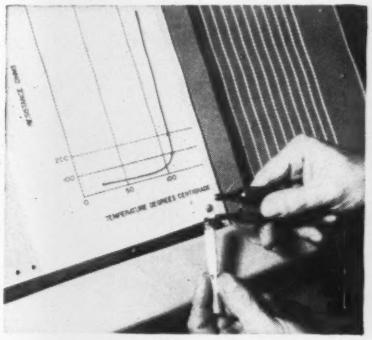
J-22160-R



Unlike remotely located sensing devices, PTC thermistors are buried in the windings of the Guardistor motor, instantly equating all temperature factors.



Ever alert PTC thermistors constantly totalize temperature, statically triggering an action *only* if critical temperature is reached.

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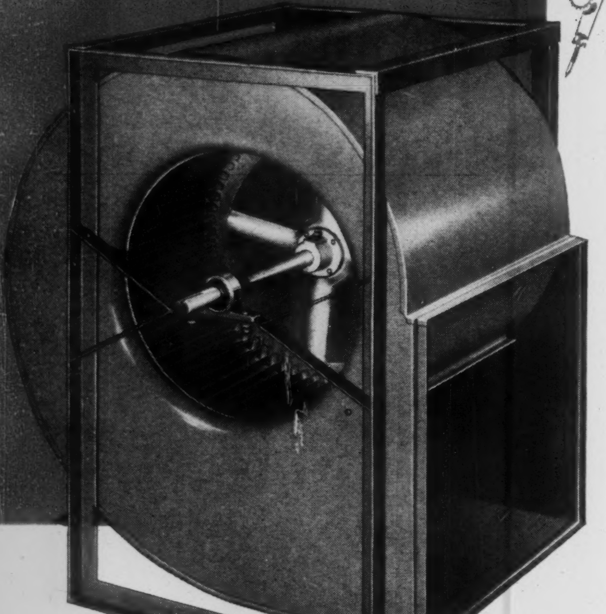
22", 25" and 30"

DESIGNED FOR COMMERCIAL INSTALLATIONS



Built-in flexibility makes the Lau "Series A" the number one choice for commercial and industrial installations. With a C.F.M. range of from 8,000 to 36,000, this efficient unit may be used in many different sizes and types of air conditioning systems. For even greater C.F.M. capacity and flexibility the "Series A" may be operated in banks of two or three.

The "Series A" features such quality Lau parts as heavy gauge riveted wheels, large reservoir oil type bearings and sturdy angle framing for housing supports and structural strength. "Series A" blowers provide for either top or rear mounting motor.

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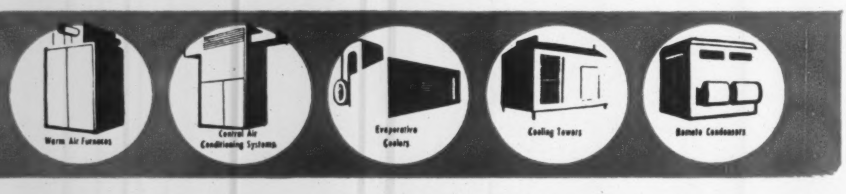
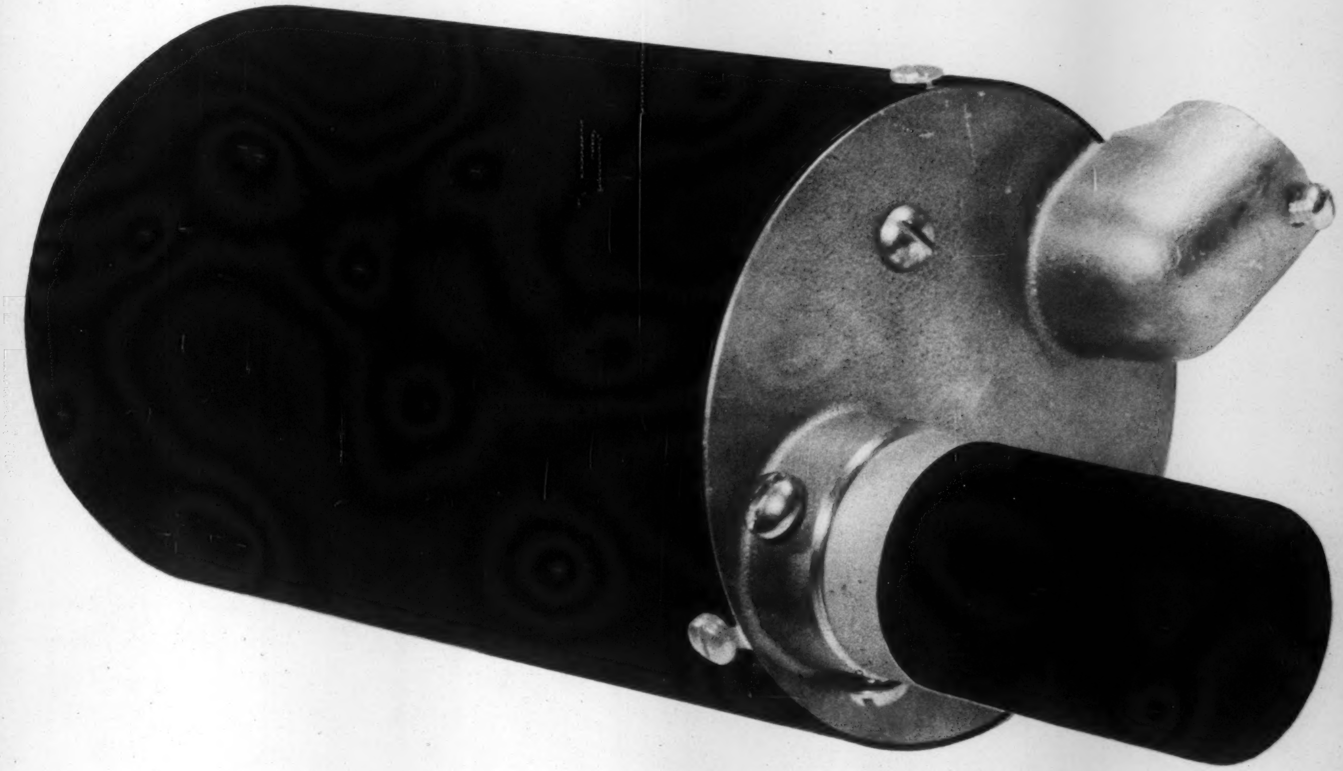


HONEYWELL'S NEW C7012A

Ultra-Vision* Flame Detector



senses only the flame!

no more hot refractory hold-ins

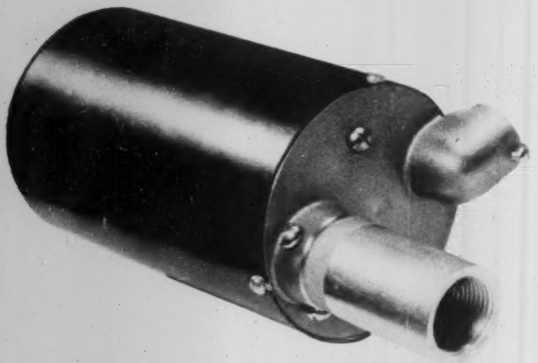
USE OF ULTRAVIOLET RAYS REVOLUTIONIZES SAFETY STANDARDS IN FLAME DETECTION DEVICES FOR GAS, OIL AND COMBINATION GAS-OIL INSTALLATIONS

Honeywell's new ultraviolet sensor represents a major breakthrough in scientific flame detection. This revolutionary device employs an amplified ultraviolet signal to positively distinguish between an actual flame (ultraviolet rays) and a hot refractory (infrared rays). For the first time, you can be *absolutely sure* that fuel delivery will be stopped in the absence of flame.

This new control device is compact. It simplifies flame supervision of both single and multiple burners since the Ultra-Vision Detector, not being sensitive to a hot refractory, can be aimed at each individual flame in the most convenient way. This is the only device on the market that offers you this advantage.

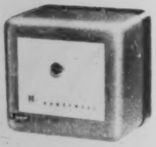
Is it economical? Consider this: The amazing new Ultra-Vision Flame Detector will actually pay for itself in simplified installation and maintenance because— *• wiring is less expensive in this system than in a lead sulphide cell • it can be installed easier because in flame sighting hot refractory can be ignored • there is no further need for flame rod replacement.*

*Trademark



HONEYWELL'S NEW C7012 IS "SYSTEM ENGINEERED" FOR USE WITH ANY 2- TO 4-SECOND FLAME RECTIFICATION RELAY!

The Honeywell Ultra-Vision Flame Detector is designed for safe, foolproof flame detection when used with any of the following flame safeguard relays:

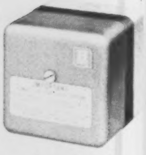


FOR MEDIUM BURNERS—RA890E PROTECTORELAY

The RA890E is a basic rectification relay ideally suited for use with the new C7012A Ultra-Vision Sensor. It's designed especially for pressure-gun oil burners, small combination gas-oil burners and gas-power burners.

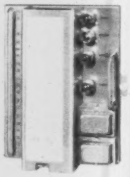
FOR INDUSTRIAL PROCESSING BURNERS AND OVENS—W124 PROTECTOGLO

Provides extended purge timings and cutoff of the main flame. Pushbutton and signal lights are a built-in feature of this system. The Ultra-Vision Flame Detector provides safe, dependable flame detection when used with the W124 Protectoglo.



FOR INDUSTRIAL PROCESSING AND COMMERCIAL BURNERS (requiring manual start and complete cutoff on flame failure)—**R485 PROTECTORELAY**

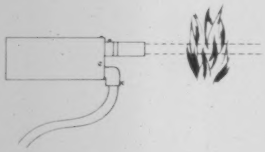
Used with the new C7012, the R485 Protectorelay insures trouble-free operation and no "down time"—this system senses only the flame, never a hot refractory. The safety features of the R485 include a warm-up timer, a self-start check and a safe-operation check for immediate shut-down in event of abnormal conditions.



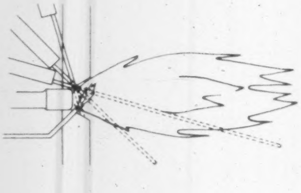
FOR LARGE CONVERSION BURNERS—R478 PROTECTORELAY

Here's an electronic programming relay for large horizontal rotaries, combination gas-oil burners, steam-atomizing burners and large power gas burners. The R478A may be used with the C7012A Ultra-Vision Sensor when burner sequencing is needed.

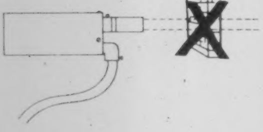
HERE'S WHY HONEYWELL'S NEW C7012 IS SO VERSATILE!



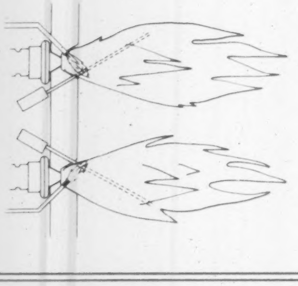
New Ultra-Vision Flame Detector sights flame of all fuels.



New Detector does an effective job on single burner pilot and main flame installations.



C7012 is not affected in any way by a hot refractory.



With Honeywell's new C7012, multiple burner installations can be monitored safely for the first time.

FOR MORE DETAILS, CALL YOUR LOCAL HONEYWELL OFFICE, OR WRITE TO HONEYWELL, MINNEAPOLIS 8, MINNESOTA; PHILADELPHIA 44, PENNSYLVANIA; OR TORONTO 17, ONTARIO

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We follow here each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

"Open for Discussion"

Makeup Air for Plant Exhaust Is Key to Tremendous Heating Savings

H. P. Kaulfuss, in his article *Supply Makeup Air for Plant Exhaust without Adding to Heating Costs* (June), has done us a great service in providing information on the economies which can be achieved in makeup air systems. His article should be of great importance to any engineer involved in industrial ventilation design.

The savings possible with the installations described by Mr. Kaulfuss are so large that they cannot be ignored. It is always interesting in such cases to do a bit of pencil work with figures. If we assume a foundry plant requirement of 1 million cfm of makeup air and an *average* air tempering requirement for the six-month heating season of 25 F over the outdoor air temperature, then approximately 28,000 lb per hr of steam would be required to heat the air. At $0.75 per 1000 lb, this would cost $21 per hour, or $507 per day. Depending on a five-day or seven-day work week, this would amount to either $66,000 or $92,000 per heating season. This is why the systems described by Mr. Kaulfuss are worth the time, effort, and installation costs put into them to permit the use of nontempered air.

Mr. Kaulfuss has pointed out some of the design requirements necessary to assure removal of the dust and fumes. However, where the fumes removed are highly toxic, extreme caution should be used with direct makeup systems. Under such circumstances, a system that would maintain safe foundry conditions might not maintain the complete, safe control required for the more toxic fumes. In other cases, some tempering may be required to avoid condensation on the supply ductwork. Cold ducts can cause a disagreeable or unacceptable plant condition. With good design, the problem can be minimized.

It should be noted also that balance of the supply and exhaust air volumes is very important to such systems. This requires good operation and maintenance, in addition to good design and initial volume adjustment. An excess of supply air would cause "blowout" at the hoods and would prevent adequate removal of stray fumes in the work area. In a foundry, this difficulty would be apparent immediately; in plants handling solvents or other nonvisible fumes, the dislocation would go unnoticed. Perhaps Mr. Kaulfuss will add a few comments regarding the means of measuring and maintaining the necessary supply-exhaust balance.

John H. Clarke
Engineering Design Supervisor
Air Conditioning and Power
Visking Co.
Div. of Union Carbide Corp.

The author's reply — Mr. Clarke's comments on my recent article are very kind and, as usual, quite thought provoking. His figures on savings which can be realized over a six-month period are very much in line with what we would use at our plant. Our cost per 1000 lb of steam would be a bit lower, but the other assumptions are quite conservative. These costs are very important, and deserve careful consideration.

As pointed out in the article, a maximum of 80 percent of the air being exhausted from a system of this kind is introduced from an outside source. This is very important, as Mr. Clarke mentions, to maintain a definite flow into the hood or enclosure, there-

(*Continued on page 94*)

CENTURY

SMOOTH, "CUSHION" START

with new Century Electric part-winding start motor

This new motor . . . at either 1200 or 1800 rpm's . . . will give you smooth, "cushion" acceleration. No cogging, jerking or jarring equipment. No sub-synchronous stalling. Just dependable torque with the same 40% reduction in starting current of all Century Electric part-winding motors.

New winding—A special winding scheme makes this extra smooth start possible. Special cross connections are made between coil groups of the basic motor winding. Result: balanced stator field on first step position . . . no cogging . . . smooth acceleration. Means that now motors will give better performance on part-winding start. Also, more time can be taken for acceleration because the winding does not go "across the line" until the rotor has reached a higher speed.

Applications—Have an application where power company restrictions limit in-rush current? The complete line of Century Electric part-winding start motors is the answer. They provide the most economical and dependable way of starting equipment with low-starting torque such as fans, blowers, centrifugal pumps, and compressors, as well as reciprocating compressors equipped with unloading valves. And with new Century Electric part-winding motors heavier loads than ever before can now be brought smoothly up to speed.

Construction—Century Electric part-winding start motors are available in approximate range of 20 to 150 hp sizes and in speeds of 1200 and 1800 rpm. They all have the high quality construction features of all Century Electric squirrel cage induction motors . . . coils are insulated with tough polyvinyl acetal resin . . . windings are dipped and baked with several coats of high temperature synthetic varnish which protect against oil fumes, mild acids and dust and grit . . . rotors are dynamically balanced so that motors run with extreme quietness and smoothness . . . rugged cast iron frame construction assures long life and low noise level.

Application aid—A Century Electric application engineer will be glad to discuss your part-winding start problems with you. Century Electric also makes a complete line of motors . . . all sizes and types from 1/20 to 400 hp. For a copy of the new Century Electric Motor Application Guide, please write for bulletin 270A.

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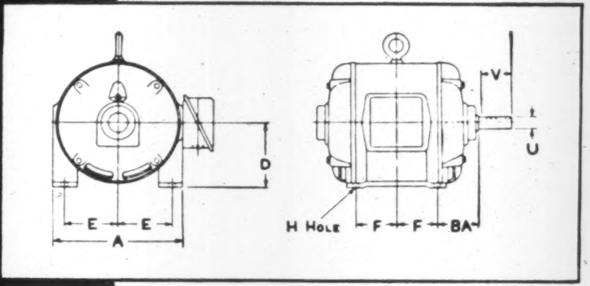
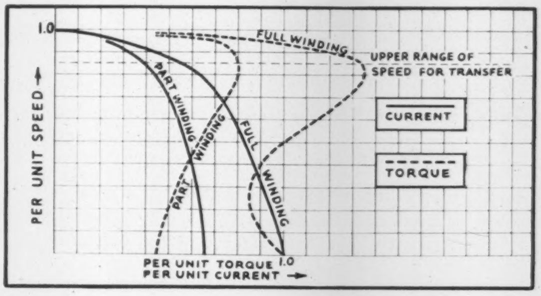


TYPICAL 30 HP part-winding start motor dimensions

Frame Size	Key	A	BA	D	E	F	H	U	V
SC 326U	½ x ½	16	5¼	8	6¼	6	21/32	1⅞	5⅜



SPEED-TORQUE curves show how transfer to full winding can be made at higher speed after current has fallen off.

"Open for Discussion"

Continued

by preventing the escape of gases or fumes into the surrounding areas. In balancing a system of this type, air flow instruments are used, and damper positions are locked and marked.

Condensation on the cores and castings has not been critical, due mainly to the residual heat surrounding the intake ducts themselves, as well as that from the area. Direct impingement of cold air on castings could be a source of trouble, as pointed out by Mr. Clarke, and must be carefully considered. In some cases, it might be necessary to temper the outside air somewhat to guard against a condition of this kind.

H. P. Kaulfuss
Staff Engineer
Peoria Plant Engineering
—Caterpillar Tractor Co.

Incinerator Smoke Problem Proves Poor Exhaust System Balance

The article, *Apartment Building's Negative Pressure Gulps Smoke from Incinerator Doors*, by G. H. Hama and L. C. Curley (June), describes a situation that occurs too frequently, namely, unbalanced supply and exhaust air quantities. The information presented by the authors suggests the following questions:

1) Have the designers of this "ultra-modern" apartment building been questioned as to the reason for designing the exhaust system for 59,100 cfm and the supply system for 17,400 cfm?

2) Wouldn't a power exhaust fan for the incinerator needlessly increase the already excessive movement of the air through the building? The supply air quantity of 18,610 cfm should provide sufficient ventilation for 620 people at 30 cfm per person, or 1240 people at 15 cfm per person. How many occupants does the building have? And how much ventilation air is needed? Wouldn't reduction of exhaust air from 45,750 cfm to 18,610 cfm be more practical?

3) How does the 4500 cfm fan recommended for the incinerator stack compare with the incinerator combustion air requirements?

4) Even if the supply and exhaust fan deliveries were balanced, shouldn't the fan motor switches be equipped with interlocks to prevent the exhaust fans from operating without the supply fans?

5) What means of preventing negative pressures in the building would the authors recommend, other than keeping the supply and exhaust air movement in balance?

R. A. Parsons
Board of Water & Light
Lansing, Mich.

The author's reply — I will attempt to answer Mr. Parsons' questions in the order he asks them.

1) The designers of the apartment have been questioned as to the reason for the 59,100 cfm exhaust and 17,400 cfm supply ventilation. Correspondence received from them in answer to the inquiry has not answered the question.

2) I do not believe that power exhaust will cause excessive movement of air through the building. Actual air movement is not perceptible, except possibly at supply outlets. Mr. Parsons may have meant that it will increase the already high negative pressure. If so, this is true, as we are exhausting more air. Supplying more air is definitely the best engineering approach. However, where this cannot be done, the problem must be met and power exhaust in this instance appears to be the only economically feasible approach. Reduction of exhaust air would cause a toilet and kitchen odor nuisance. The present designed figures are 110 cfm for kitchen exhaust and 85 cfm for bathroom exhaust. This is definitely minimal. The building has no openable windows in its 340 apartments which house, at present, approximately 600 persons.

3) The minimum calculated incinerator combustion requirement is 3700 cfm, based upon information from the Detroit Bureau of Smoke Abatement.

4) The interlocks switch for supply and exhaust fans is a good idea where the system is in balance. (However, with the present off-balance of the system, it can only function satisfactorily with the exhaust fan *off*. For this reason, it would be a good idea to retain separate switches).

5) Fixed air inlets or motorized louver inlets of sufficient size would relieve the negative pressure. However, these could be only used in climates where the outdoor air temperature is not too low. Normally, where cold winter climates are to be faced, a heated makeup air system would be needed.

George M. Hama
Senior Associate Industrial Hygienist
Bureau of Industrial Hygiene
Dept. of Health
City of Detroit

"System Characteristic Curve" Is Really Friction Drop in Piping

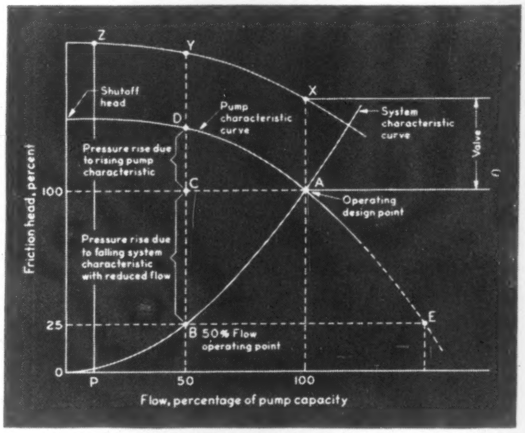
In Fig. 1 of J. W. Scharres' article, "*Direct Throttling is Good Hot Water Pressure Control*" (May), the line curving up to the right from the origin is designated the "system characteristic curve." This is obviously in error, since it is impossible to draw a system curve when, as in this instance, the flow is regulated by control valves.

Actually, the line represents the friction drop in pipe, fittings, and coil which varies approximately as the square of the velocity (or gpm) and, as Mr. Scharres points out, the control valve must absorb the difference between the head developed by the pump at any flow rate and the corresponding point on this line.

He indicates this as the pressure equivalent to the difference between points *D* and *B* on the diagram (for 50 percent flow).

The valve must also absorb this difference at the design flow, but Mr. Scharres indicates no such difference. He indicates the design operating point as the intersection of the piping characteristic curve and the characteristic curve of the pump so that the valve would have no resistance whatsoever at that point and, consequently, would be entirely useless as a control device.

One valve manufacturer suggests that the valve should be selected on the basis of a pressure drop at design flow about equal to 50 percent of the pressure drop through the rest of the circuit. Obviously, the head developed by the pump must be equal to the sum of the piping plus valve friction. I have indicated the corresponding pump curve on Fig. 1.



1 REVISED PUMP CHARACTERISTIC curve *XYZ* considers pressure drop through control valve

Even though the duty of a control valve on a LTHW air heating coil is, by long odds, the most difficult of any in the field of heating (e.g., a 95 percent reduction in flow will result in a reduction of only about 70 percent in heat output), the valve should provide satisfactory control if selected on the suggested basis. Certainly Mr. Scharres' statement that "the obvious result" (of increased pressure drop due to reduction of flow) would be very poor control of flow . . ." is a very considerable exaggeration.

Mr. Scharres' arrangement would permit a considerable reduction in the design pressure drop of the valve(s), but it should be noted that if it is to be effective, the throttling valve must, itself, be selected with a definite pressure drop, so that the "saving in operating cost" claimed by Mr. Scharres is more imaginary than real.

The differential pressure controller and valve suggested are certainly more costly than a supply temperature "reset" control arrangement. If this is employed, the duty of the control valves is made much less difficult than even with Mr. Scharres' arrangement (reduction of heat output follows reduction in the flow much more closely). If the valves are properly selected, no difficulties need be anticipated.

J. P. O'F. LYNAM
Senior Mechanical Designer
Daniel, Mann, Johnson & Mendenhall & Associates
A Joint Venture
Architects & Engineers

THE AUTHOR'S REPLY — I believe that Mr. Lynam has misinterpreted my diagram. It was my intent to show the characteristics of the pump and main circulating system up to, but not including, the controlled convector and its control valve. This was done by way of analysis to show only the part of the system upon which the control valve must work, and, by so showing, better appraise the job the control valve must do. Why is this impossible?

I then proceeded in the fourth paragraph to consider what that duty might be, supposing that the control valves were able to accomplish the reduction of flow desired. Since the physical aspects of the main circulating system remain unchanged, I think that the curves are valid hydraulically and that they show what the control valve must do.

I am in agreement with the practice of sizing control valves for a wide open pressure drop of 50 percent of the frictional pressure drop through the "rest" of the circuit. (That is why I drew my diagram to show the "rest" of the circuit.)

My article did not suggest that pump pressure regulation would eliminate the need for central water temperature control from outdoor temperature. My purpose was to show that pressure regulation is required and how best to accomplish it.

I believe that, first of all, every hot water heating system needs central water temperature regulation from outdoor temperature. Secondly, if individual radiator control on all or part of the system is desired as a refinement, then pressure control on the system is required to make the individual throttling valves effective.

The extremely nonlinear heating characteristics of heating coils with varying water flow and the similar nonlinear flow characteristics of circulating systems both impose a control duty too severe to permit the omission of any of the above mentioned three elements if accurate control is to be accomplished with proportioning control equipment.

J. W. SCHARRES
Chief Engineer
E. R. Gritschke & Assoc.
Consulting Engineers

(*Continued on page 96*)

"Open for Discussion"

Continued

Questions Author on Points Covered In Fuel Oil Preparation Article

THE ARTICLE, *Proper Fuel Preparation Is the Key to Efficient Fuel Oil Combustion*, by D. S. Frank (June), has been read with interest. This article is very timely and is of an informative nature that should be interesting to all heating and air conditioning engineers.

Reference is made in the article to "National Bureau of Standards Specifications." Strictly speaking, fuel oil specifications are not prepared by the National Bureau of Standards. These standards are voluntary standards prepared by a committee in the trade representing oil producers, burner manufacturers, oil distributors, and oil users. Such Commercial Standards are quite different from the type coming under the jurisdiction of the National Bureau of Standards. It is unfortunate that the author did not give credit to the American Society for Testing Materials Standard D-396. Commercial Standard CS12-48 is almost identical to ASTM D-396, and most of the work done in keeping this standard up to date results from technical and engineering activities carried on by ASTM Committee D-2.

Reference is also made to the relationship between Saybolt Universal and Saybolt Furol viscosity. It is pointed out that the relationship is generally taken to be 10 to 1. It is also desirable to point out that while Saybolt Universal viscosity is generally taken at 100 F, Saybolt Furol is taken at 122 F, with the result that the relationship between the two is generally approximately 20 to 1 at these two temperatures, although there is no exact relationship because of variations in viscosity index.

The author points out that the permissible viscosity of No. 6 fuel oil can range from a low of 45 SSF to a high of 300 SSF. This points out an area which can be troublesome when No. 6 oil is burned in completely automatic heating plants without the attention of an operating engineer and without means for measuring the fuel oil viscosity to determine the best temperature to provide the desirable viscosity for the particular burning system. In large boiler plants there are generally instruments available for measuring the fuel oil viscosity. But in the smaller plants this equipment is generally not available and, unless the oil supplier is careful to supply fuel with a uniform viscosity, operation may not be as good as it should be.

Manufacturers of rotary cup atomizing burners may take exception to the author's comments that these burners and low pressure air atomizing burners are very sensitive to viscosity. One of the outstanding advantages of the rotary cup type of atomizer is its ability to atomize oil at relatively high viscosity. While approximately 350 SSU is considered as a very desirable viscosity for rotary cup atomizers, these units, when properly adjusted, operate well up to 750 SSU; many are in service with fuels of even higher viscosities.

The principal problem is not so much the viscosity of the oil as it is the *uniformity* of the viscosity. A burner adjusted for 150 SSU does not do well at 750. Proper selection of atomizing cup and air nozzle permits the rotary cup burner to atomize relatively heavy fuels as compared with some other types of burners. In the author's example, where it was necessary to go to 220 F with a viscosity of 150 seconds, probably the same results could be obtained at 180 F with the proper selection of cup and nozzle.

The author's discussion of the wide range of viscosity permissible under present Commercial Standard specifications points out the desirability of submittal of specifications for purchase of fuel to be used in completely automatic plants. For example, the purchasing agent might specify CS5-250 to describe a No. 5 fuel oil with a viscosity of 250 seconds.

R. C. WRIGHT
Vice President, Engineering
Iron Fireman Mfg. Co.

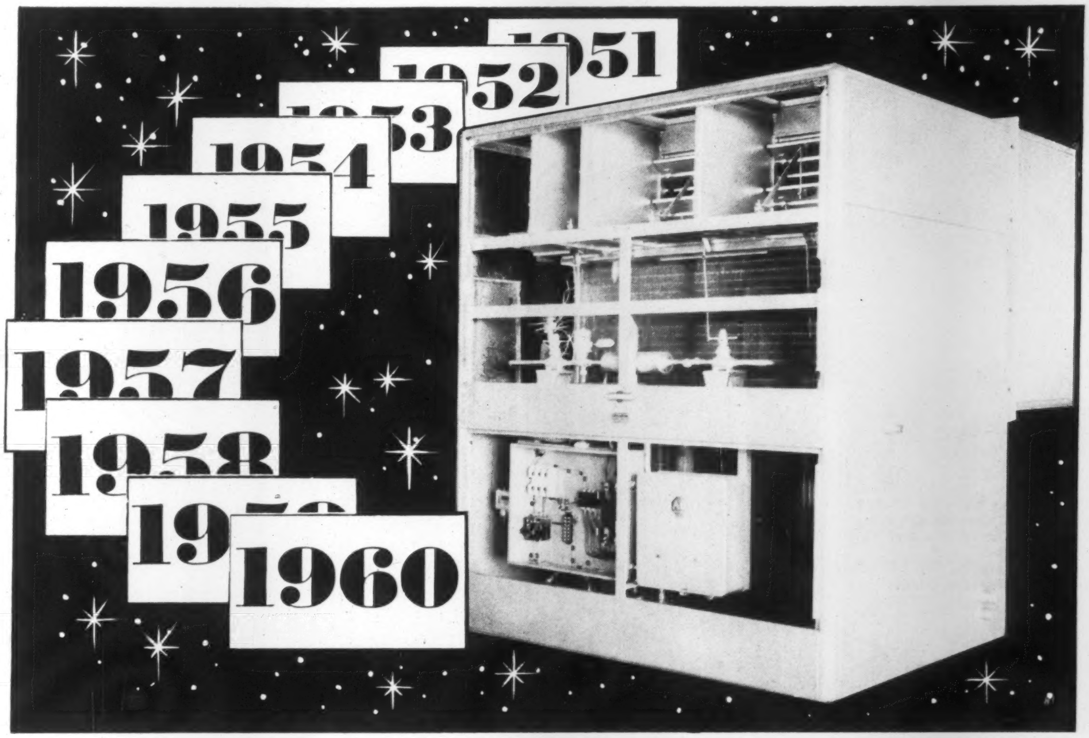
THE AUTHOR'S REPLY — Mr. Wright's comment on the origin of the voluntary standard of the trade is well made. In the interest of brevity, the reference in the body of this article was given as "National Bureau of Standards Specification." This is amplified in the list of references as "Commercial Standard CS12-48, U. S. Department of Commerce."

With reference to relationship of Saybolt Universal viscosity and Saybolt Furol viscosity, the article reflects the viscosity at the same temperature. Too often, a user of fuel oil can become confused when trying to reconcile the two viscosities at different temperatures, i.e., 100 F for Saybolt Universal and 122 F for Saybolt Furol. In the interest of trying to clarify the relationship, the viscosities were stated at the same temperature.

It is recognized that there are installations of rotary cup atomizing burners and low pressure air atomizing burners operating at higher viscosities than given in the paper. This does not infer that improved results could be obtained at the lower viscosity. Certainly the mechanical features of a burner must be correlated for maximum efficiency.

Residual fuel oil is an end product of refining and any restriction of specification is undesirable from both a supply and a price situation.

D. S. FRANK
Assistant Manager, Utilities
The Pure Oil Co.



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in self-contained multi-zone units

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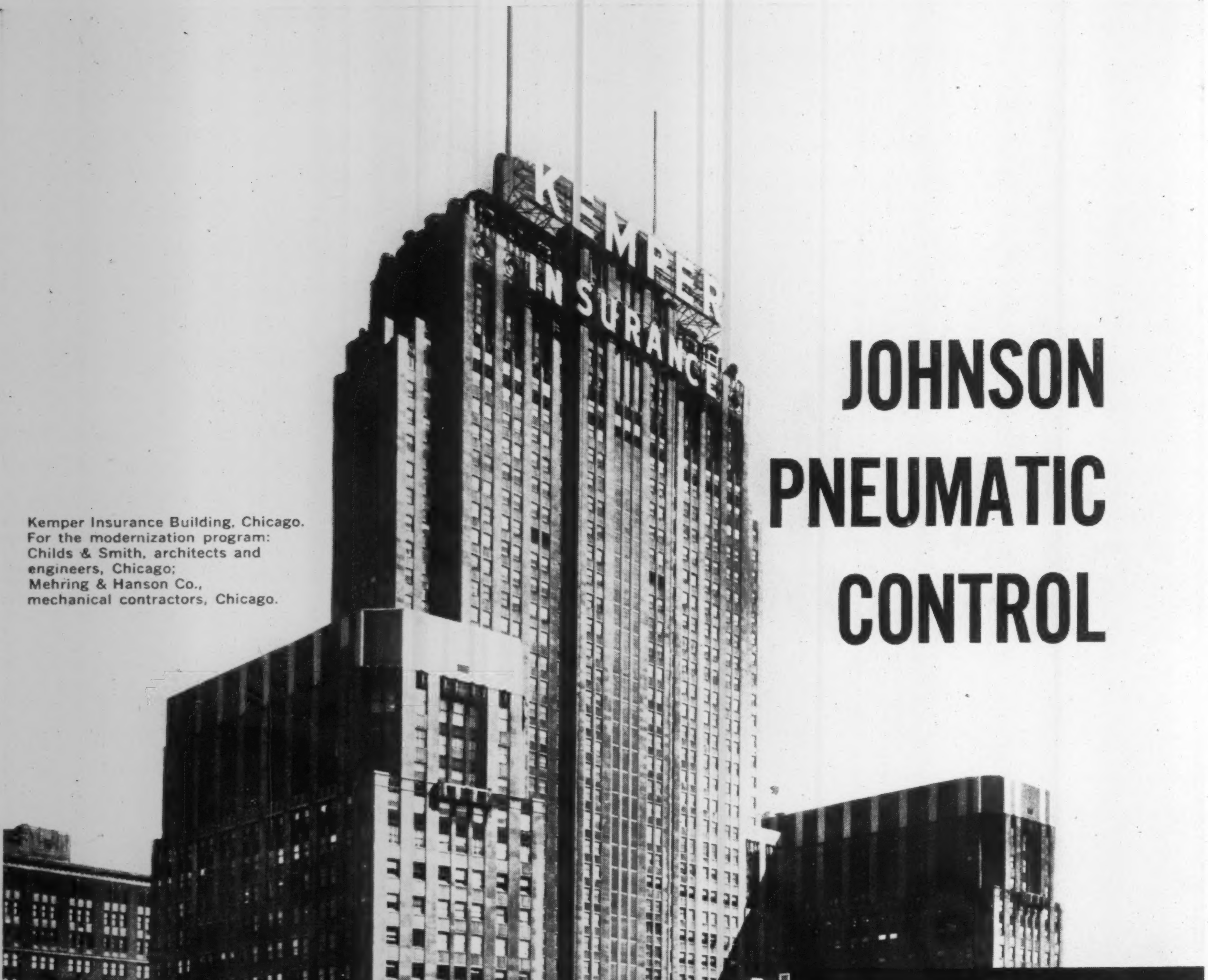
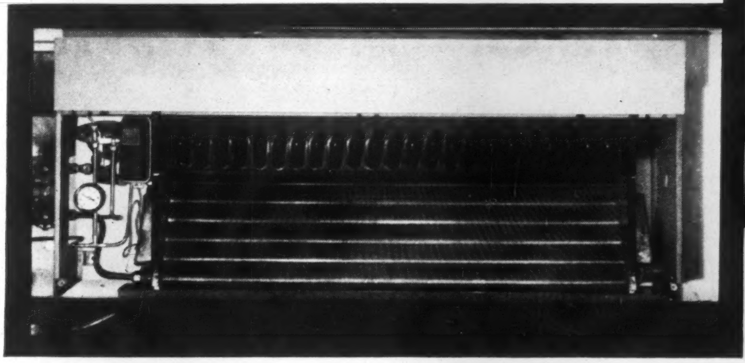


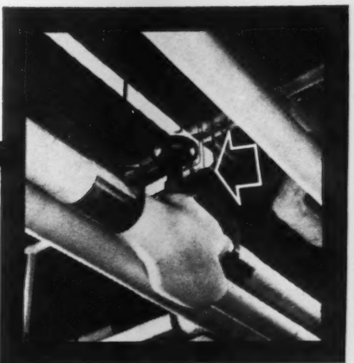
JOHNSON PNEUMATIC CONTROL

Kemper Insurance Building, Chicago.
For the modernization program:
Childs & Smith, architects and engineers, Chicago;
Mehring & Hanson Co., mechanical contractors, Chicago.

Over 2,000 Johnson thermostats maintain an ideal climate for business. Individual office controls eliminate a major cause of complaints, contribute to tenant satisfaction.

Johnson thermostats and water valves control over 3,100 induction units. These popular valves have an unmatched record of trouble-free service in such installations. The air gauge simplifies thermostat calibration, allows thermostat and valve operation to be checked at a glance.





Johnson 3-way mixing valves and by-pass valves can be serviced without removal, an exclusive Johnson feature that cuts service time over 50%. They also permit simple straightaway piping hookups for faster installation.

...assures ideal comfort, lowest lifetime costs

FAMOUS CHICAGO SKYSCRAPER SHOWS HOW IT'S DONE

CHILDS & SMITH
C&S
ARCHITECTURE
ENGINEERING

As one of Chicago's top-rated buildings, the Kemper Insurance Building (formerly the Civic Opera Building) demanded air conditioning controls that would meet the very highest comfort standards. For economy, thrifty planners wisely also insisted on reliable, trouble-free controls.

A specially planned Johnson Pneumatic Control System meets both of these requirements. It provides coordinated operation of air conditioning systems supplying conditioned air at the rate of 600,000 cfm. The complex installation includes 8 large central fan air conditioning systems, 5 secondary water systems, and more than 3,100 underwindow induction units, all of which are Johnson-controlled. Offices throughout the 42-story modernized structure are individually regulated to maintain a comfortable, productive working climate for some 5,700 people.

Being pneumatically operated, the Johnson System functions dependably and with a minimum of supervision and upkeep. Both the system and its components incorporate economy features that result in important long-range savings.

Johnson Pneumatic Systems are designed and installed to provide the finest in modern comfort control at the lowest possible lifetime cost to your clients. A nearby Johnson engineer will welcome the opportunity to explain how these advantages can be applied to your next building or air conditioning project. Johnson Service Company, Milwaukee 1, Wisconsin. 105 Direct Branch Offices.

1123

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

question of the month

"How Should We Size Relief Valves For HTHW Water-to-Steam Converters?"

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with answers that have been received from readers. Other solutions or comments for publication are invited.

> ***"Water-to-steam converters are required in many high temperature hot water heating systems. An important part of the design of the converter is the sizing of the relief valve. We have been unable to locate specific data covering this. We would like to know whether such data exists, and if so, where it can be found. Also, we would like to know how other designers size relief valves for this application." — J.S.B.***

Size For Greatest Steam Quantity Possible to Generate in System

No PUBLISHED DATA on the sizing of steam relief valves is known to be available other than that indicated in the code for Unfired Pressure Vessels, available from the American Society of Mechanical Engineers. The safety valve should be sized for the maximum quantity of steam that can be generated under any conditions that can arise in the system.

The capacity of a water to steam converter, evaporator, or reboiler whichever you wish to call it is dependent upon a number of factors, namely:

a) Square feet of heating surface
b) Entering water temperature
c) Leaving water temperature
d) Pounds of water flowing per hour
e) Steam pressure generated

All the above factors will affect the output. However, some are less subject to variation.

Once the design has established the steam pressure, the sq ft of heating surface, and the maximum inlet temperature, only two variables remain that can change during normal operation. These are lb of water flowing per hr and leaving water temperature. Theoretical calculation can establish the lb of water required for any given set of conditions.

For instance, assume the following conditions:

Steam capacity, 6000 lb per hr at 50 psi and at 300 F
Feed water at 212 F
Entering high temperature hot water, 380 F
Leaving high temperature hot water, 320 F
Difference in enthalpy, 63 Btu per lb

then

6000 lb × 1000/63 = 95,000 lb per hr

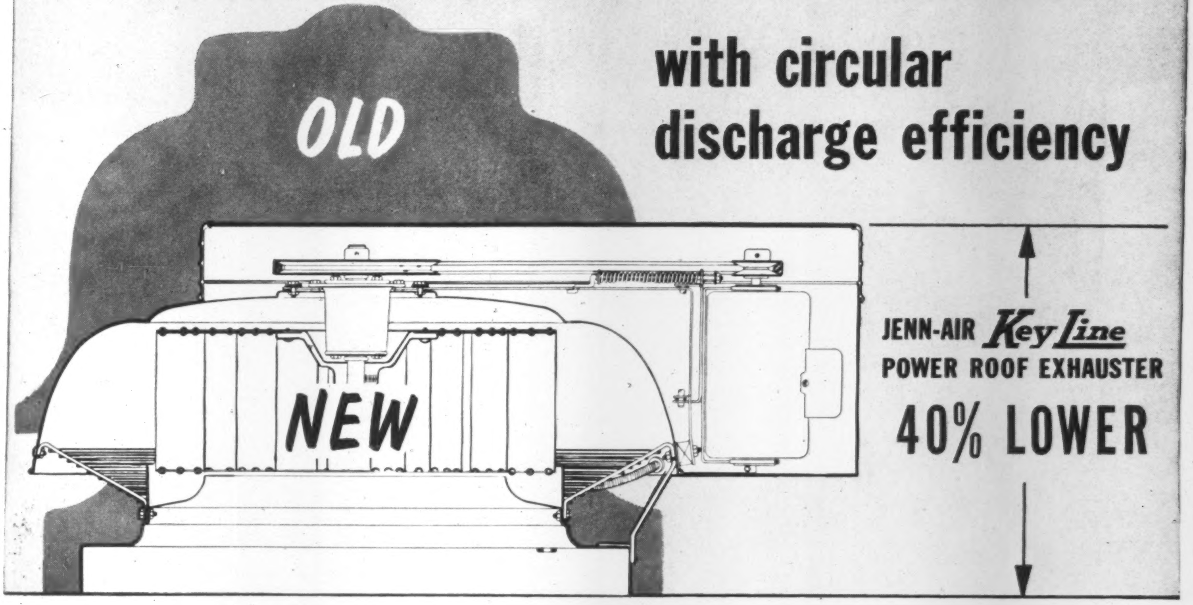
The high temperature hot water control valve would be sized to pass a maximum flow of 95,000 lb per hr with the pressure available. The safety valve would be sized to relieve the maximum quantity of steam that could be generated with 95,000 lb of water or 6000 lb of steam without permitting a rise of more than 10 percent above the allowable working pressure.

In practice this may vary. The pressure available may be greater due to over design and the control valve may be oversized. This will permit a greater flow than the 95,000 lb per hr and possibly a lesser temperature difference between entering and leaving water. With a fixed amount of heating surface, the

(Continued on page 104)

LOWEST CONTOUR OF ANY UNIT

with circular discharge efficiency



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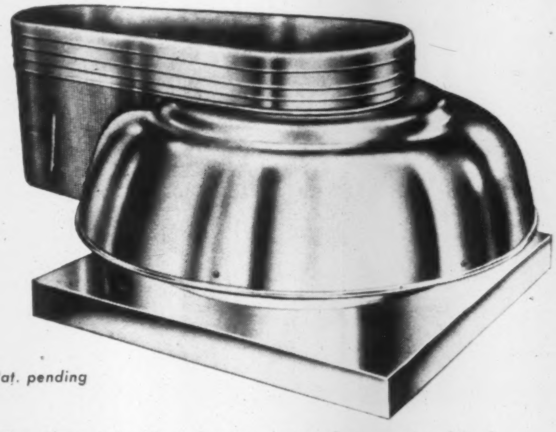
40% LOWER



Pat. pending

. . . and motor and drive are out of air stream!

Check these other KEY features:

- Maintenance-free spun aluminum housing
- Ten-year-lubricated ball bearing motor mounted out of air stream
- Drive with permanently sealed and lubricated ball bearings
- Heavy cast iron pulleys, adjustable to permit speed variation
- Belts with long drive centers for extra-long wear
- Automatic belt tightening device to assure constant fan speed . . . no service call-backs for adjustment
- Built-in bird guard
- Hinged curb for damper access (optional)

The Jenn-Air KEY LINE meets the most critical standards for styling, quiet operation and air moving efficiency . . . it's the key to better ventilation in any roof installation. Centrifugal or axial models. Capacities from 725 to 27,000 cfm. Write for Bulletins 60-CK (centrifugal) and 60-AK (axial).

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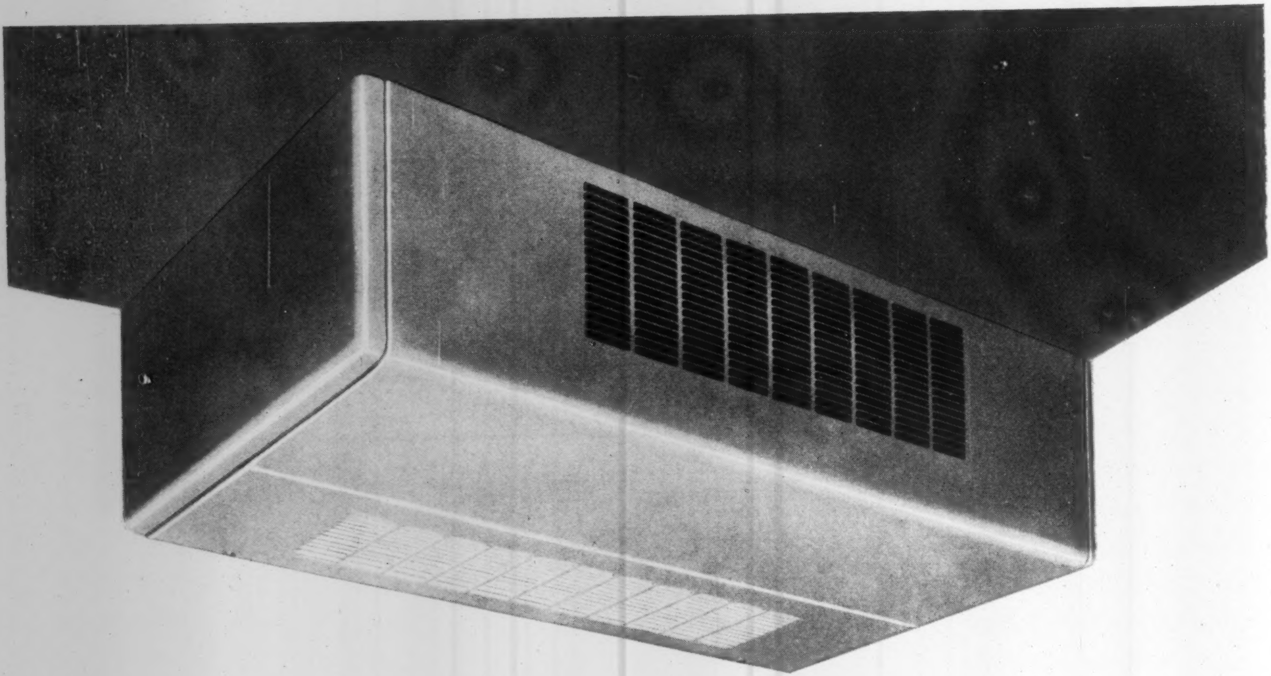
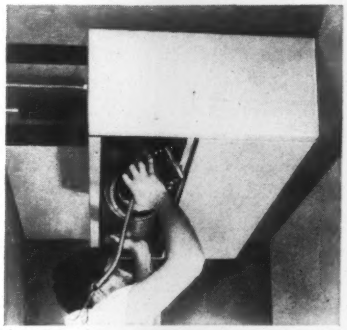


EXPOSED!

FAN-COIL UNIT NOW IN



Now you can specify the Type 30 American-Standard year 'round hydronic* air conditioning unit EXPOSED! It is ideal where floor and wall space are limited or where it is not convenient to provide dropped ceilings or furred-down spaces for concealed installations. ■ Thermally and acoustically insulated cabinets are specifically designed for easy installation and convenient access to the installed unit. A choice of three air-inlet arrangements assure conformance to individual requirements. ■ Either neatly concealed or attractively exposed, the Type 30 Remotaire offers the latest advantages in central system hydronics through such features as: complete operating flexibility with a wide choice of packaged controls, built-in motor speed regulation, and economical electrical characteristics. Four test-rated capacity sizes from 200 to 600 cfm are available. ■ For full information see your American-Standard representative or write

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AMERICAN-Standard
PLUMBING AND HEATING DIVISION

**Hydronics—the science of cooling and heating with water.*

question of the month

Continued

generator will reach equilibrium somewhere above 6000 lb of steam.

Our recommended empirical approach to normal steam generators is to calculate the capacity of the safety valve at design conditions, size the control valve as closely as possible and provide two safety valves, each capable of relieving the maximum steam generated at design conditions. As the size of this type of equipment seldom exceeds 10,000 lb of steam per hr, the insurance of the double valve is not so costly as to make it uneconomical and the vessel is protected against a variation in operating conditions.

A more vigorous approach would require complete capacity curves for the heat exchanger giving capacity in terms of temperature difference and water flow (lb per hr). From the curves the maximum capacity could be determined for any possible condition and the safety valves sized accordingly.

William T. O'Reilly
Seelye Stevenson Value & Knecht
Consulting Engineers

If Relief Valve is Needed, Size As Per Normal Boiler Design Practices

If the steam side of the system has a pressure rating equal to or above the saturation pressure corresponding to maximum water side inlet temperature, no steam type safety valve is needed. A water-heater type safety pressure valve is required, however, in case the converter steam side happens to be filled with cold water and valved off, and hot water is subsequently allowed to enter the normal water side. Since this valve has only to accommodate liquid expansion, a small size should be adequate.

A converter of the type mentioned is just another type of boiler, and if the rating of the steam side of the system is lower than the saturation pressure, then the steam side should have steam-type safety valves rated in full accordance with normal boiler design practices. The water side may be thought of as the "burner", with the maximum Btu input occurring under conditions of maximum water side inlet temperature, maximum water flow, and maximum heat transfer conditions.

Maximum water flow must be found from the pressure-volume curves for the converter and the water system, assuming the converter water control valve is jammed open. Steam side flow should be assumed as zero so that all steam generated must go out the safety valve discharge.

Heat transfer surfaces should be assumed clean and all pipe surfaces smooth for conservative safety valve selection. For small converters, quick selection can be made assuming perfect heat transfer so that the valve will handle the input water Btu less output water Btu at the water temperature corresponding to saturation conditions at the safety valve pressure setting.

It goes without saying that both the converter and valves should be code approved and stamped and the entire system designed in accordance with applicable code provisions. Just as important is proper piping of the safety valve discharges, as well as periodic opening of the valves and normal piping maintenance.

John A. Weber
Professional Engineer

READER ASKS —

"How Can We Protect Boilers' Internal Metal Surfaces?"

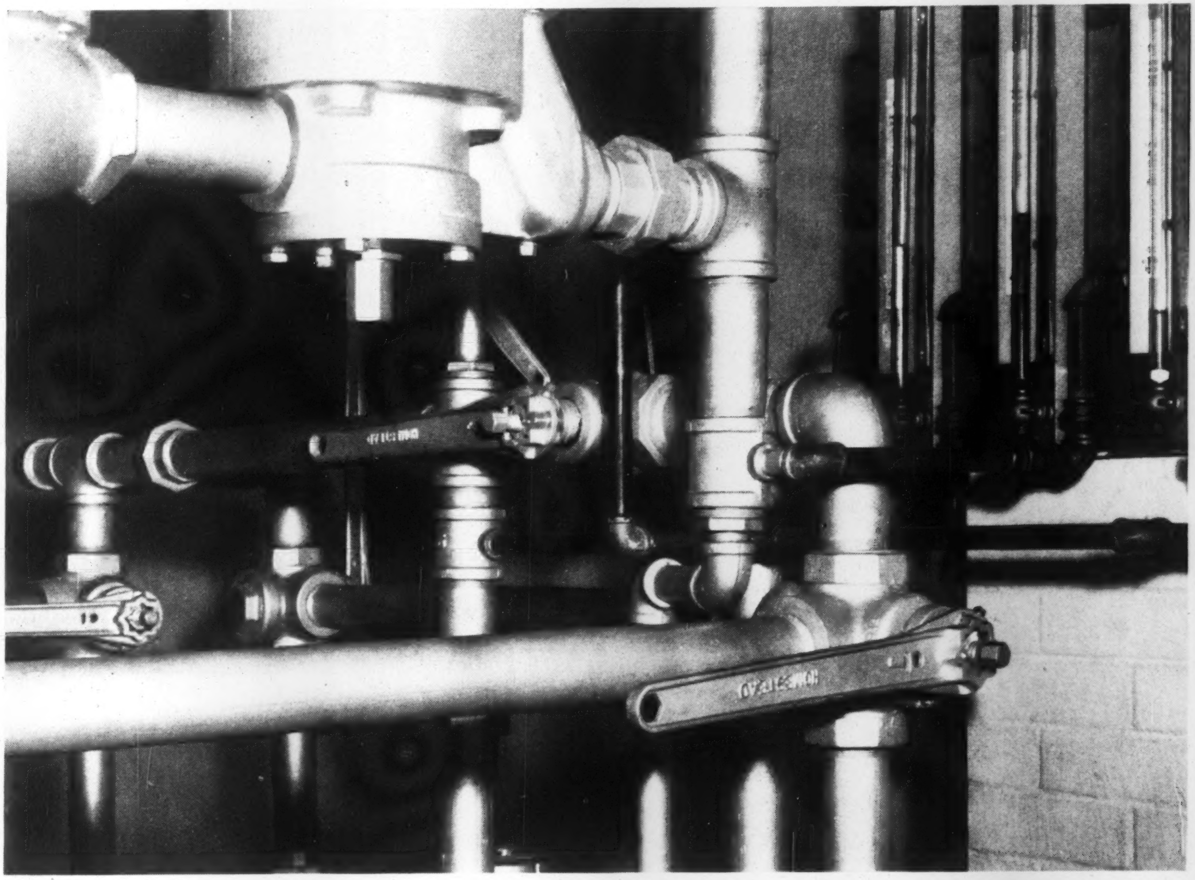
"A problem we have been encountering is the deterioration of the internal metal surfaces of our steam and hot water boilers, as well as some heat exchangers. This condition seems to get worse with higher temperatures.

"Are there any compounds or surface coatings available which retard or prevent this deterioration? If so, how are they applied? What are their compositions? What temperature and pressure limitations should be considered in their application?

"Any information others can offer will be greatly appreciated." — P.D.W.

YOU ARE INVITED to contribute a question for publication or an answer to a published question. Write: The Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

CLOSE TOLERANCE—KEYNOTE TO LOW-COST MAINTENANCE—is yours with Homestead® Lubricated Plug Valves. Vital to efficient fluid control, this close tolerance between sealing surfaces



(.002″ maximum clearance on sizes up to 2″, .003″ to .005″ maximum on larger sizes) plus Homestead's high-pressure lubricant system guarantee complete coverage of sealing surfaces. You are assured protection against corrosive, abrasive or erosive line fluids as well as a longer-lasting seal against leakage. Sticking is eliminated, too, by downward movement of plug during each lubrication. The net result for you is positive fluid control at very low cost per year.

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"Serving since 1892"
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Please send Reference Book 39-1 and prices on Homestead Lubricated Plug Valves:

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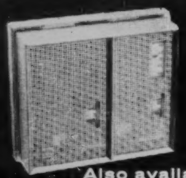
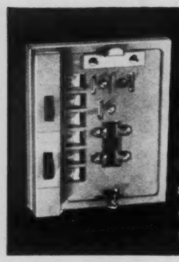
Company..
Address...
City..................................Zone......State....................

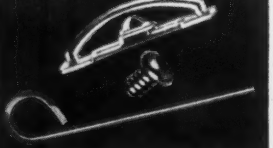
New "standards"



Also available in electronic dual-element type

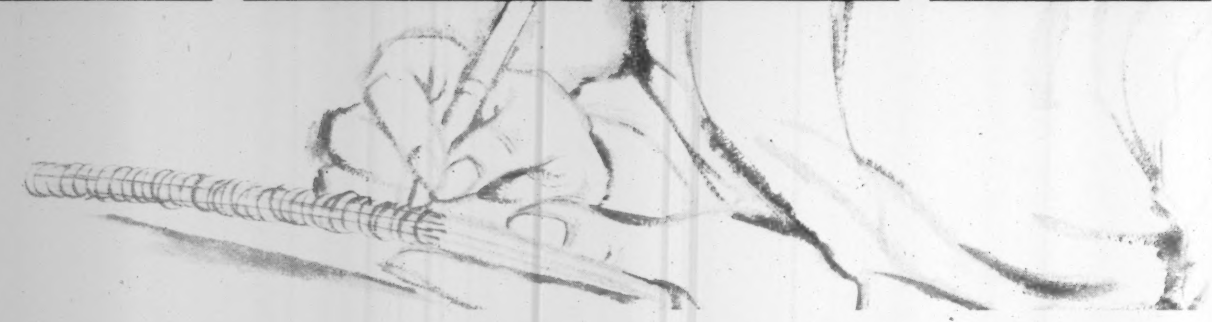


Typical subbase neatly accommodates control switches



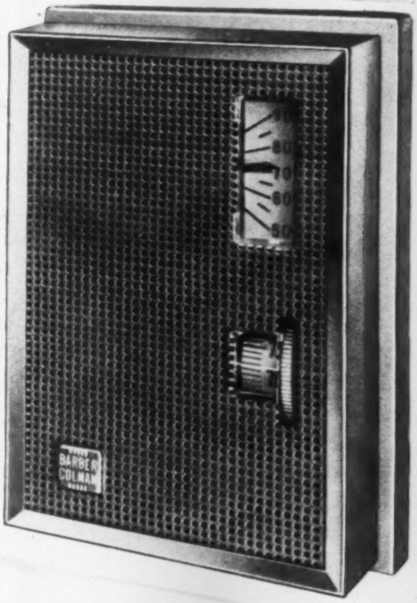
Accessory kit modifies thermostat to prevent tampering

Literature



in room thermostats

Broad new line of room thermostats includes standard catalogued variations to meet every requirement



Now a broad new line of versatile room thermostats is offered by Barber-Colman to meet every requirement. You can select the exact thermostat you need from a very wide range of basic styles—all are *standard* items—all are *completely catalogued* for your convenience.

24-120-240 volts. There are light-duty models for on/off control of relays, solenoid valves, and other pilot-duty applications—medium-duty models for control of heaters, motors, and other heavier load applications. Both types conveniently operate on low or line voltages (24, 120, 240) as required. Room microtherm models provide proportional control of Barber-Colman motor-operated valves, damper motor operators, and sequence controllers.

Night depression—heat anticipation. All thermostats in this versatile new line are available with resistance heaters for night depression or heat anticipation. Perforated faceplates permit unrestricted air circulation for maximum temperature sensitivity. A clear plastic cover protects the wide-scale temperature dial. Graduations are easy to read—there is a mark for each degree. A precision bimetal thermometer clearly indicates a room temperature from 50° to 90°. The sturdy bakelite base has large screw-type terminals. Standard finish is champagne gold, but a polished chrome cover frame with a bronze perforated metal insert is also available.

Add-on construction. Easily added matching subbases that neatly accommodate a wide variety of manual switches contribute to the versatility of the new line. The switches are SPDT types with or without center "off" position for such functions as: switching from heating to cooling control, day-to-night control, or automatic to full "on."

Cover kits. A lock cover screw kit will modify these thermostats to prevent tampering. Guards are available for protection from external damage in auditoriums, gymnasiums, and factories, as well as special fittings for use with exposed conduit.

BARBER
COLMAN

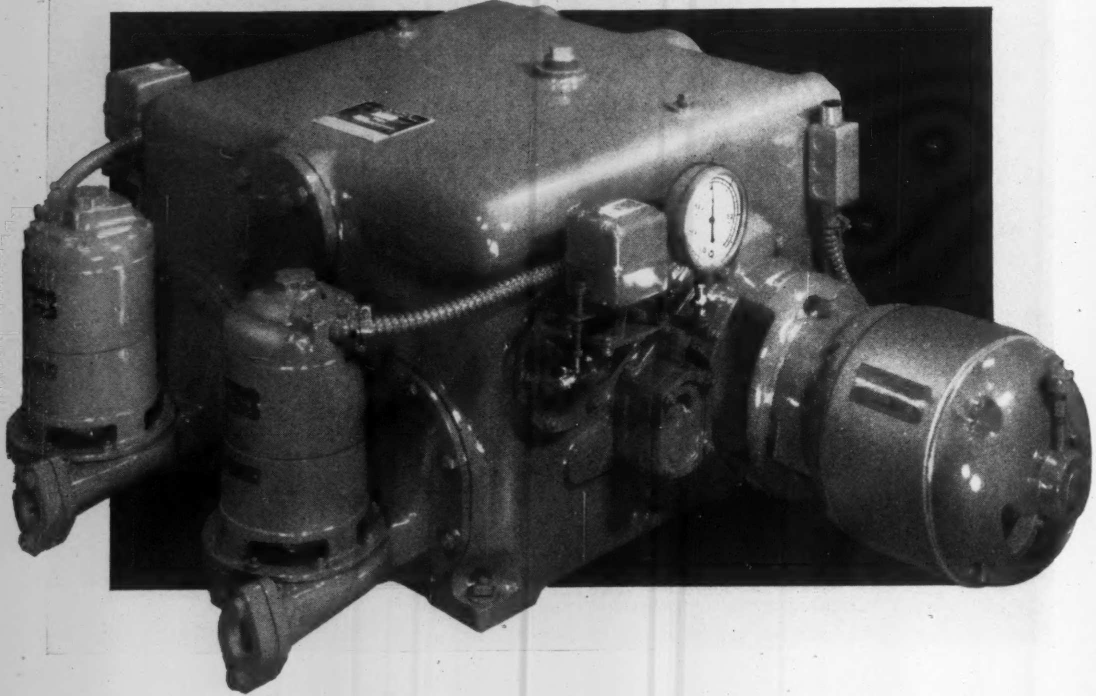
Next time you specify room thermostats, select the exact models you need from the broad new Barber-Colman line. Be assured of quality, installation ease, and sensitive, reliable operation.

Ask for Bulletin F-10201. Call your local Barber-Colman Automatic Controls office or write:

BARBER-COLMAN COMPANY
Dept. J, 1301 Rock Street, Rockford, Illinois

THIS NEW VACUUM HEATING PUMP

HAS THE INCREASED AIR CAPACITY EFFICIENT HEATING PRACTICE DEMANDS



It's the Nash CSM

Designed and manufactured by the organization that made the Jennings Manifold Heating Pump standard of the Heating Industry, the new CSM incorporates every desirable feature architects, engineers, owners and operators have sought. Employing separate air and water pump elements, each with its own motor and each independently controlled by its own automatic switch, the capacities and arrangement may be widely varied to meet job conditions. For the first time, the engineer has the choice of realistic water and air capacities required for rapid system response without wasteful overheating.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- ✓ Increased air capacity induces rapid system response without wasteful overheating.
- ✓ Separate air and water pumps individually selected to meet actual job requirements.
- ✓ Control system that operates individual pumps only when needed.
- ✓ Flexibility permitting addition of radiation without changing basic pump installation.
- ✓ Low, low, return line connection.

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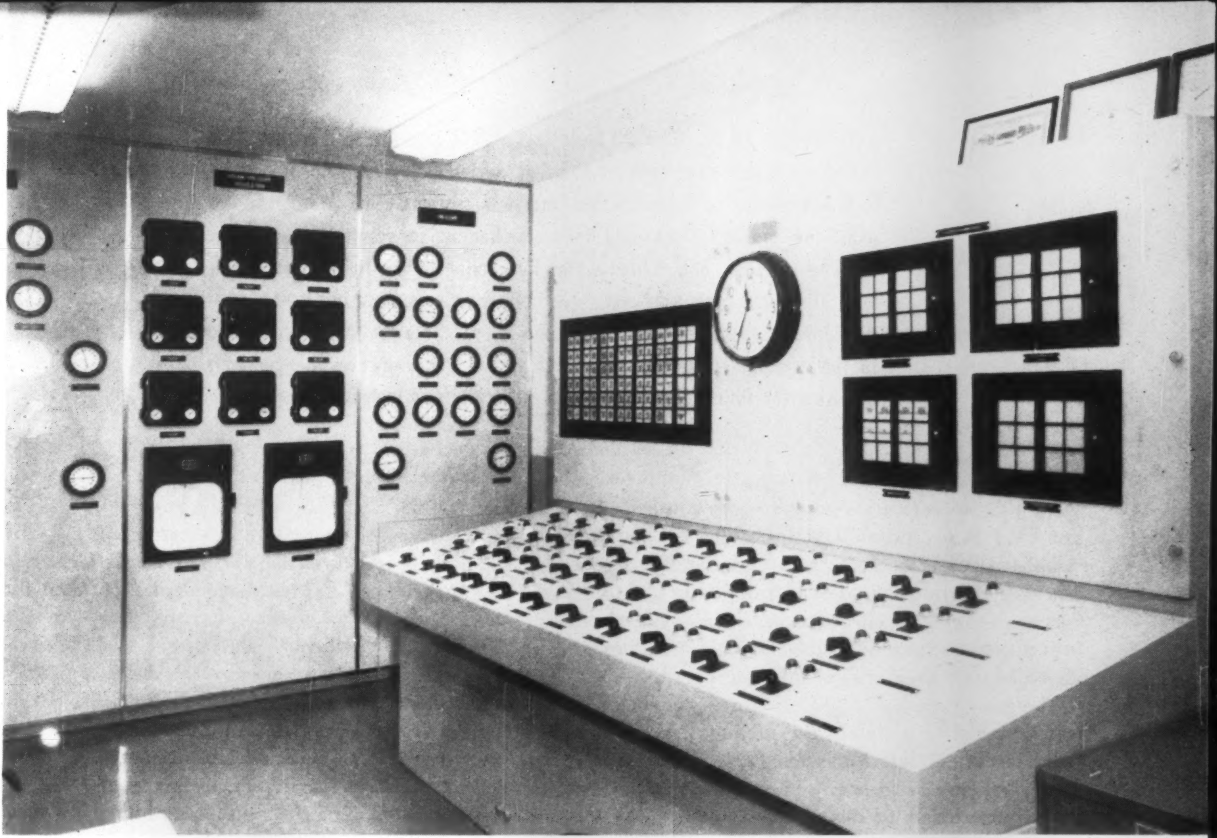


CONTROL ROOM for integrated system is located in central utilities building, contains complete indicating and control equipment for supervision of the entire system

Old and New Combined For Multi-Building Year 'Round System

By STANLEY T. KANNO
Chief Mechanical Engineer
Wilbur Watson Associates

- ***best use of existing equipment***
- ***economy in space requirements***
- ***provisions for easy expansion***
- ***architectural-mechanical harmony***

THE HOME OFFICE facility of The Ohio Oil Co. in Findlay, Ohio, consists of a six building complex located within the limits of the downtown business district. These buildings are interconnected by a system of tunnels and bridges, and are provided with mechanical services from a two-story central utility building.

The architectural development of the complex is interesting in that it points up the good effect of long range planning for both occupants and designers.

The first large six story central office building was designed and engineered by Wilbur Watson Associates and constructed in 1929. Additions were made to this structure in succeeding years, and in 1956 the current expansion program was begun.

• Conversion of The Ohio Oil Co.'s home office facilities to a central year 'round air conditioning system is being carried out through a process of careful planning to integrate old and new systems. The central utilities plant now provides steam and hot water heating services to the entire six building complex, and chilled water for cooling to the two newest buildings. The same cooling towers serve both the new system and central station units in the older buildings. In the future, these too will be converted to the one chilled water system. Of special importance is the generous provision for future expansion needs built into this well integrated plant.

By 1958, construction of the central utility plant and of a three story marketing building had been completed. One of the original three story general office structures and other small buildings completed the complex at that time, but construction had already begun on new general offices which would provide an additional nine stories of working space.

The new Marathon building is now completed. It was designed to maintain the architectural spirit of the adjacent and interconnected 1929 building, but in such a manner as to provide for future expansion to a maximum height of 20 stories.

Central Plant Serves All Buildings

Our principal concern, then, is with the new structure, the older office building and the smaller marketing building. All buildings in the complex now receive heating services from the central utility plant. In addition, the marketing building and new structure are furnished with chilled water cooling from the same central location. This results in a system of split delivery within the utility building which we will consider later.

The new structure was designed on a 5 ft modular basis so that perimeter space could be divided into office units of from 10 to 200 ft in length, in 5 ft increments. Various year 'round air conditioning systems were considered, in relation to the modular unit requirements, floor heights, exterior wall construction, and other factors.

We wished to avoid a sacrifice of valuable floor space, and at the same time to avoid unsightly pilasters on an otherwise flush exterior wall. Still the requirements were for extreme flexibility within the system to accommodate the possibility of frequent shifting of inside partitions when the needs of the occupants changed.

Choose Fan-Coil System

The final choice was between a dual duct high velocity system with perimeter radiation or a fan-coil system using low velocity air distribution and interior zoning. The fan-coil system was finally selected on the basis of owning and operating costs, largely because the architectural and structural characteristics of this particular building were better adapted to that system.

Chilled water at 45 F is circulated to 127 fan-coil units located along perimeter walls of the new building and to central air handling units in interior spaces. Hot water, with temperature modulated according to weather conditions, is supplied to the coils from a shell and tube steam-to-water heat exchanger located in the utilities building. The same system is used for the smaller marketing building.

The older eight story office structure is heated directly with steam from the central source by means of radiant convectors. A series of built-up multi-zone central station units which operate by direct expansion are used for summer cooling. Zoning within this building is in accordance with the arrangement of the various bays in the structure.

Match System to Modular Concept

The use of the fan-coil units in the new building had to be reconciled with the modular concept of construction. In other words, individual room control had to be maintained even when inside partitions were shifted to accommodate changing work requirements. The fan-coil units, in general, are spaced on 10 ft intervals. Ventilation air is supplied through conventional low velocity ducts and introduced at intervals matching those of the fan-coil units.

Approximately 50 percent of the air is re-circulated. Zoning is on a building-exposure basis, and re-circulation is accomplished through multi-zone units which are dew point controlled and equipped with electrostatic filters.

Interior spaces are conditioned by similar multi-zone units via ducts and ceiling diffusers. Air return in both cases is through corridors and return air shafts located near the center service core of the building.

In a few cases, where central areas are isolated from corridors, the ceiling plenum is used to return air to the shafts. Excess air is relieved into equipment rooms, crawl spaces, and pipe tunnels.

Plan for Future Expansion

In order to serve the diverse requirements of this expanding complex, the central utilities structure had to be carefully planned with adequate provisions for future expansion. Early consideration of present and future demands on mechanical facilities enabled us to avoid the too-often encountered problem of insufficient space for proper maintenance and operation of the large amount of equipment needed for a project of this size.

Within the two-story utility building, all heating facilities and the partial central cooling system for the entire complex are housed. This includes the numerous pumps required for hot and chilled water circulation and a complete control center.

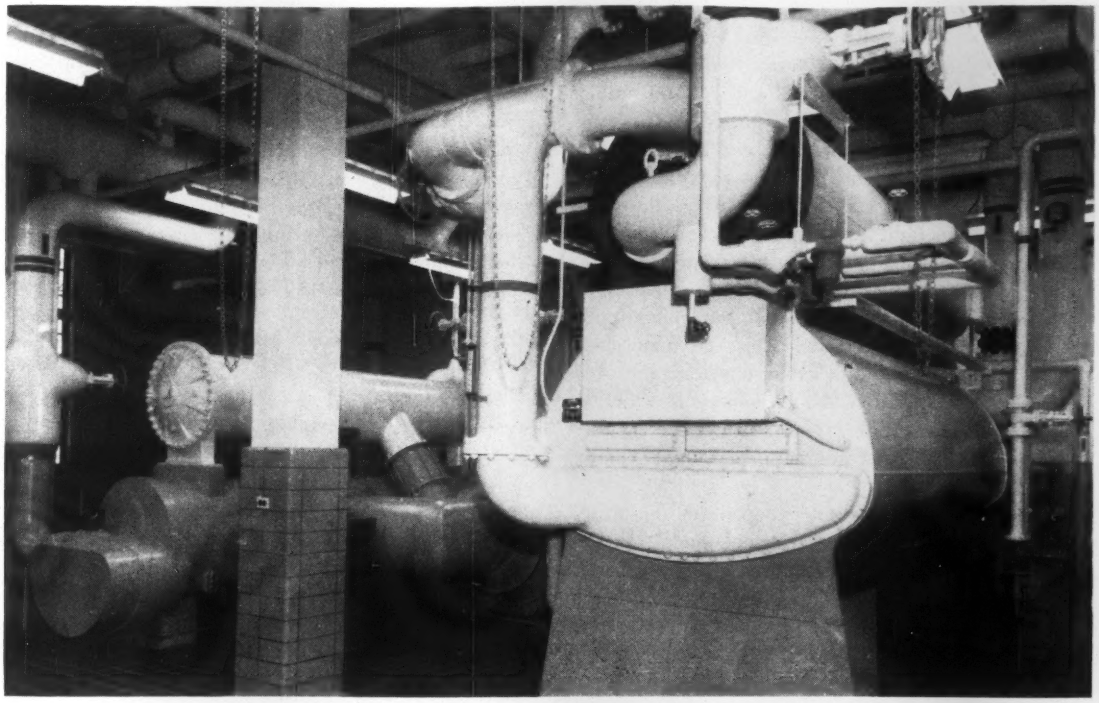
Two packaged steam boilers, each rated at 26,000 lb of steam per hr, are installed on the first floor. A single boiler can carry the entire heating and cooling load even during winter months. Thus, the second unit remains in a standby capacity, and will furnish the additional capacity needed when the new office building is increased to 20 stories. Space is allowed for the installation of a third boiler if it is required in the future.

Steam is generated at 150 psi for driving turbines connected to boiler feed pumps, condenser pumps, and a fire pump. Steam is also delivered at that initial pressure to the hot water heat exchanger used to supply the numerous fan-coil units. Pressure is reduced to 45 psi before it leaves the building to be used in outdoor air tempering and for kitchen purposes, and is further reduced to 15 psi to fill the heating requirements of the older office buildings. Steam distribution to these remote locations is accomplished via piping installed many years ago in anticipation of the present central system, through 14 × 9 ft underground tunnels.

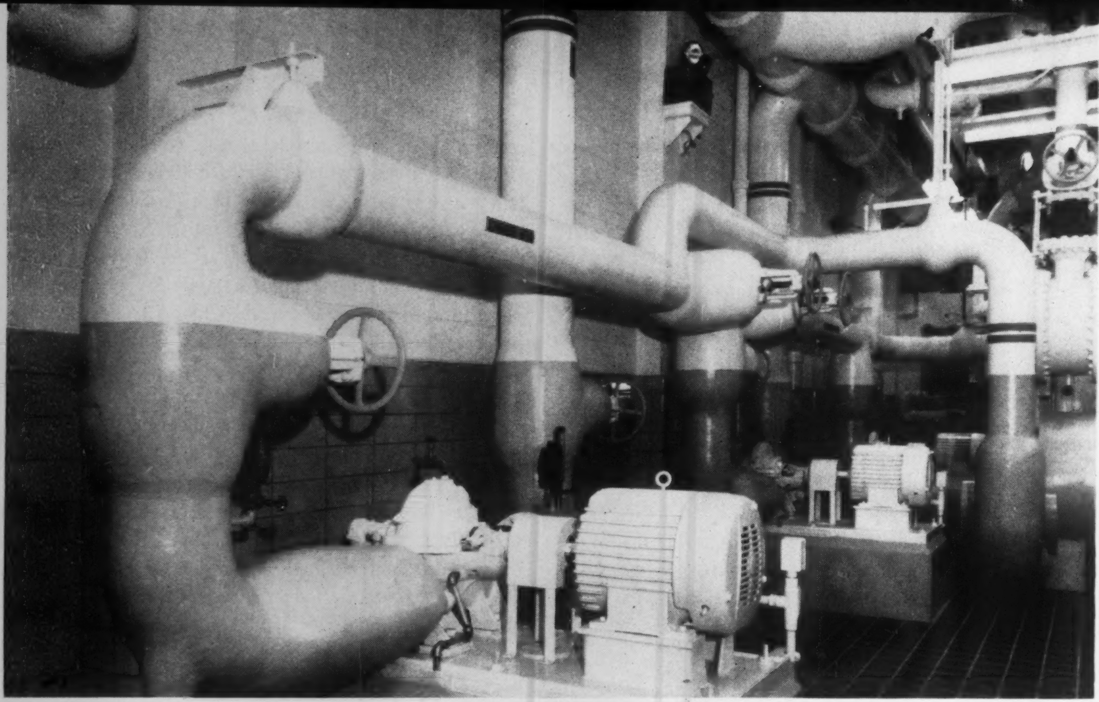
Two 125 gpm pumps handle the return of condensate from the collection tank to the deaerator. One of these operates continuously and the other cuts in automatically when the condensate tank level rises. A pneumatic control valve throttles the discharge to achieve a constant flow to the deaerator and thus eliminate slugging.

Use Steam and Electric Pumps

Boiler feed water passes through a preheater and is delivered to the boiler by means of one steam turbine-driven and two electrically-driven vertical pumps. Steam driven pumps are used for various purposes throughout the system in conjunction with the electric units to achieve maximum utilization of available steam.



CENTRIFUGAL AND ABSORPTION-TYPE CHILLERS, used in combination, provide flexibility and maximum efficiency during periods of light load on steam plant. As heating load increases, steam demand for absorption machine drops



MAIN CHILLED WATER LOOP, 16 in. in diameter, is served by two horizontal pumps, with third unit for standby

Two hot water loops from the heat exchanger are used; one for the new office building and the second for the smaller marketing building. Two 20 hp centrifugal pumps provide hot water circulation in each loop. Again, adequate space has been provided for the addition of a third loop and circulating pumps when the new building is extended.

The central air conditioning system was designed for efficient operation under current conditions and for easy expansion to meet future needs. Two 400 ton refrigeration machines are located in the utility building. One of these is absorption type, operating on steam from the central boilers, and the other centrifugal. This combination provides maximum flexibility and allows maximum efficiency in the light load ranges. The light load problem proved especially acute in this installation because of an electronic computer area located in the new building. This space requires cooling year 'round, and is equipped with a separate chilled water loop. An under-floor supply plenum and ceiling exhaust plenum are used to maintain correct operating temperatures in the computers, while comfort requirements are met by means of an overhead supply plenum and ceiling diffusers.

A main 16 in. chilled water loop inside the utility building is served by two horizontal pumps, with a third installed as a standby. Three secondary loops, one each for the new structure, marketing building, and computer area, are each served by two 1600 gpm pumps.

An air conditioned, glass enclosed control room on the first floor of the utility building contains complete electrical indicating and control equipment for the entire system. From this station, the operating engineer can keep a running record of operating data, see that heating and cooling demands in remote locations are being met, and start or stop almost all of the equipment. Only the boilers need be controlled from outside this center.

The second floor contains an electrical transformer room.

Structural members of the utility building extend up through the roof to support two double-cell induced draft cooling towers. These are piped for year 'round use, and an auxiliary sump has been installed inside the boiler room. The towers serve both the central chilled water system and the central station systems used to cool the older buildings. Again, both electric and steam turbine driven pumps are used for condenser water circulation. A separate pump unit supplies the central station air conditioners.

More Equipment Will Be Added Later

Plans for continued expansion of the complex involve, besides the third boiler mentioned earlier, the installation of two 800 ton centrifugal water chillers to convert the air conditioning systems in the older buildings to the central supply facility. Two additional cooling towers will then be required. Part of this installation will be accomplished, of course, whenever the top 11 stories for the new building are constructed.

The successful integration of new and old systems within the complex has proved again the soundness of careful and long range planning. +

Photos courtesy of Ingersoll Rand Co.

Building Design Trend Paves the Way For Integrated Lighting, Cooling

• With the trend in modern building design toward ever larger external glass areas (and consequent solar heat gain) and higher internal lighting levels (radiation), the design of economical cooling and heating systems for these structures is growing more and more complicated. One way to cope with the increased cooling loads imposed by this movement is by integrated lighting — air conditioning. This article explains some of the physical principles behind such a system and relates advantages and costs.

By WILL S. FISHER
and JOHN E. FLYNN
Product Planning and
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MODERN LARGE building design trends are familiar to all of us and are applauded by most. But two characteristics of most new buildings—larger external glass areas and higher interior illumination levels — act in concert to complicate the task of the mechanical designer who seeks to furnish adequate, efficient, and economical cooling and heating services.

Larger glass areas introduce the factor of higher solar heat gain to perimeter areas. Higher illumination levels impose a need for greater cooling capacity and may introduce a problem of uncomfortable radiation effect upon the building's occupants.

Not so long ago, lighting levels were considered in ranges of units and tens of footcandles. Now many users think in terms of hundreds and some in even thousands of footcandles for certain applications. Tomorrow's draftsman, for instance, may work under 500 fc of illumination where he can achieve his best visual performance in terms of comfort and visibility.

Of course, the heat output of an electric light source is a function of the power consumed and not of the light output. Improved efficiencies in lamps and the general shift from incandescent to fluorescent types have brought about a greater efficiency in lighting per watt of power used. But regardless of the type of lamp, heat is emitted at the rate of 3.415 Btu per watthour of energy required.

Stated another way, a 150 watt incandescent and a 40 watt fluorescent lamp yield approximately equal lumen outputs, or units of light, but the fluorescent lamp will emit less than one third as much heat. Even so, the tremendous increase in footcandles applied in many commercial and industrial areas during the past few years means an increased lighting heat gain for which compensation must be made.

To illustrate the magnitude of lighting as a heat load, it is estimated that in office buildings where about 100 fc of general illumination is provided, heat from lighting accounts for approximately 35 percent of the cooling load imposed upon conventional air conditioning systems. When the lighting level is increased to 200 fc, the heat from this source accounts for about 55 percent of the cooling load. At 400 fc, it is approximately 70 percent.

Yet, we are rapidly coming to realize that higher illumination levels are so important to the cause of real productivity that it is economical to provide the light and stand the extra cost of removing the additional heat for comfort purposes. Much can be done, however, to enhance the economic aspects of such installations.

Some Methods Limited

Conventional air conditioning techniques are used successfully today in many cases where higher level illumination is used. The designer can plan for additional capacity, more frequent air changes (often up to about 20 per hour), or lower input air temperatures to neutralize the heat gain from several hundred footcandles of illumination.

Such conventional measures have their limitations, however. At this point the second architectural design factor mentioned earlier must be considered. When greater solar heat gain through larger exterior glass areas is imposed upon the cooling system in addition to the higher lighting heat loads, the capability of a conventional air cooling system to achieve thermal comfort in the perimeter areas of some buildings may be exceeded. The system might easily handle interior spaces, but be unable to neutralize the total heat gain in perimeter areas without creating drafts, cold spots, or condensation on ducts.

Raises Lamp Efficiencies

There is another economy factor that should be considered. The output and efficiency of fluorescent lamps may be substantially affected by the ambient temperatures. For example, a fluorescent tube operated in motionless air with an ambient temperature of 100 F produces about 12 percent less light than the same tube at 77 F. Since many fluorescent lamps are operated in fixtures when ambient temperatures of 80 to 120 F may be achieved, it becomes desirable to remove some of the heat in order to obtain higher lamp efficiency.

Under conditions which require cooling, then, either for reasons of outdoor temperatures or because of solar or other heat gain, this additional heat input from the light source must be either mechanically removed by ventilation or compensated for by means of a larger capacity cooling system or, even more significant in terms of economics, a substantial part of it can be removed through ventilation before it imposes itself on the air conditioning system.

On the other hand, under those conditions which require heating of outdoor or recirculated air, a lighting system represents a significant heat source which, if properly utilized, can reduce the capacity requirements of the heating plant. Up to the present, lighting as a heat source has been little used because lighting loads were relatively low, and even if they were high enough to be significant, the heat from lights has not been controlled to advantage.

Put Facts to Use

We should now consider putting these facts to use. The result can be an integrated lighting and year 'round air conditioning system that takes full advantage of the energy available.

One of the possibilities presented by controlling lighting heat is illustrated with the heat pump. Because the heating requirements of most buildings are greater than the cooling requirements in terms of Btu capacity, a heat pump is usually sized to take care of the cooling requirements. This means that supplementary heating — usually electric strip heaters — must be used. There may also be in many buildings the paradoxical demands for cooling of interior spaces at the same time the perimeter areas need heating.

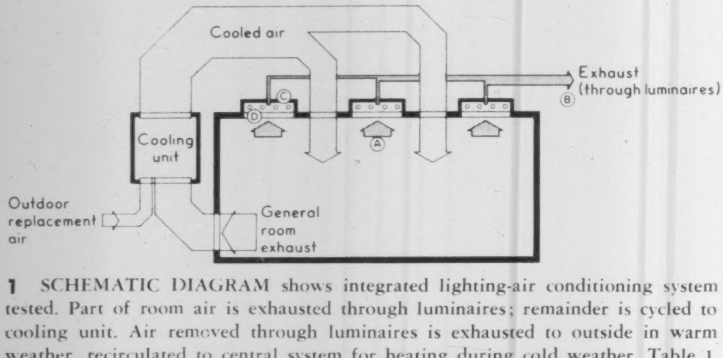
Lighting of a quantity in keeping with today's standards may bring into better balance the heating and cooling requirements of heat pumps and also permit the excess lighting heat in the interiors to be transferred efficiently to areas where it is needed. Such systems can eliminate the need for supplementary heating and improve the overall economics of heat pumps.

Electric Light Heat Source

Heat transfer from a light source occurs both by radiation and by conduction-convection. Consequently, control of the heat emitted must be both by management of the temperature gradient between source and object and by air circulation methods.

It should be noted that a larger percentage (41 *vs* 20) of power input is given off as conduction-convection heat from a fluorescent lamp than from one of the incandescent variety. As previously stated, however, three times the wattage is required with an incandescent lamp to yield the same amount of light, and consequently a stated amount of fluorescent lighting will improve the conduction-convection heat gain by about one-third over an incandescent source. At the same time, 70 percent of the power input to an incandescent lamp is emitted as infra-red radiation *vs* about 33 percent from the fluorescent tube — of a low temperature variety.

Since it is unrealistic to think of the light source in most areas



1 SCHEMATIC DIAGRAM shows integrated lighting-air conditioning system tested. Part of room air is exhausted through luminaires; remainder is cycled to cooling unit. Air removed through luminaires is exhausted to outside in warm weather, recirculated to central system for heating during cold weather. Table 1, on opposite page, includes data measured during tests at points *A, B, C,* and *D* as a bare strip installation, we should next consider the effect of the lamp-luminaire combination — a bulb or tube installed in some form of a reflective enclosure.

In the case of the fluorescent lamp employed in a fixture with an efficiency of 50 percent, we find that, of the initial power input to the lamp and its "ballast" (or auxiliary equipment for starting and arc stabilization) 76 percent of the energy will be initially confined within the luminaire enclosure. The entrapped energy includes all of that which is emitted from the lamp as conduction-convection heat, plus portions of the radiant energy and light.

Consequently, 24 percent of the energy input initially enters the room as light and infra-red radiation. In the case of the incandescent lamp, the ratio of initially trapped to free energy is about 60/40 for a fixture with an efficiency of 50 percent.

The light and infra-red rays first absorbed into the luminaire are converted to heat energy which, combined with the conduction-convection heat first entrapped, will ultimately be released to the room as heat builds up within the unit. Heat thus confined will eventually transfer to the ceiling panels and cavity above the lamp to be introduced into the room as additional heat load.

Save on Cooling Load

Consider that the 40 watt fluorescent lamp represents a potential heat source of 154 Btu per hr ($3.415 \times 40 + 3.415 \times 5$ watts for ballast requirements). If we could remove or utilize the 76 percent of this heat which is initially trapped in the luminaire, the "free heat" ultimately entering the room would be reduced to the relatively small amount of 37 Btu per hr, saving 117 Btu per hr for each 40 watt lamp. This could significantly improve room comfort and reduce the requirements for air and refrigeration. However, on a practical basis, something less than 76 percent of the heat can be controlled.

TABLE 1 — INTEGRATED lighting-air conditioning system yielded this test data. Letter designations refer to test locations indicated in Fig. 1

Exhaust volume per luminaire, cfm "A"	Watts per luminaire	Average illumination, fc	Room temperature, F	Duct temperature, F "B"	Luminaire reflector temperature, F "C"	Luminaire air temperature, F "D"
0	800	555	72	—	128	126
16	800	577	72	102	118	104
28	800	585	72	101	111	99
66	800	406	72	91	101	89
0	400	254	72	—	—	96
15	400	255	72	90	—	87
28	400	257	72	88	—	86
69	400	233	72	85	—	83
0	200	115	72	—	—	88
17	200	122	72	84	—	84
30	200	119	72	82	—	82
68	200	107	72	78	—	79

In addition to this saving in cooling load, the same lamp represents a potential reduction in heating requirements of the same amount if all the "controllable" heat could be utilized.

Let's restate the thesis: We have represented, by a higher level lighting system, a potential heat source of considerable moment. Such heat must be either removed or compensated for when inside temperatures become such as to require the introduction of a cooling effect. On the other hand, when it becomes necessary to heat all or part of a building, lights represent a potential secondary heating source. The heat emitted, however, must be controlled to be useful.

The two obvious methods of directing heat emitted from lighting to either controlled discharge or useful heating purposes are by air circulation or by some means of heat exchange to circulating water.

Several Ways to Do It

Several means of integrating modern lighting fixtures with an air conditioning exhaust system are now possible. For example, a very common method of lighting is to use troffers recessed in a suspended ceiling. If the troffer reflectors have apertures for air circulation, it would be possible to exhaust air from the room through the troffers into an exhaust duct system.

Another method is to install the lamps at one level and to place, beneath the fixtures, louvered panels at the desired ceiling height through which exhaust air can then be drawn.

Or, lamps can be mounted as by the second method, but entirely enclosed by full ceiling panels of glass or plastic. In such an installation, exhaust air is drawn from the room, or from the outside, then directed through the lighting cavity to carry off the exhaust heat.

By any of the above means, the air exhausted through the lighting system will carry away heat before it affects room comfort. This air may be exhausted directly to the outdoors and replaced by conditioned air, or when the exhaust temperature is lower than the outside air it may be recirculated.

Can Use Circulating Water

An alternate method to air circulation control is that of employing circulating water tubes mechanically attached to the luminaire to carry away the heat which the luminaire surface absorbs.

Such a system implies a reduction in building volume since water tubes replace the larger air ducts required in an air system, but does not eliminate the need for the minimum air circulation required by the codes.

At Nela Park an office demonstration area of 25 × 35 ft has been set up which can provide as much as 500 fc of illumination with both visual and thermal comfort. The system employs four-lamp recessed fixtures in louvered luminaires, installed in rows and connected to a main discharge duct above the ceiling. Maximum total wattage within each luminaire is 800. The lights are operated on a dimming circuit for tests and demonstrations.

The rate of air exhaust through the slotted louvers can be controlled and the rate of heat transfer to the exhaust air is measurable. By means of the dimming apparatus, tests were conducted at 25, 50, and 100 percent loading, to vary the illumination level, the wattage within each luminaire and, consequently, the potential heat gain.

Test Results Outlined

The test arrangement is diagrammed in Fig. 1 and the results outlined in Table 1. It should be realized that the data obtained at the lower loadings were for performance indications only, and should not be construed as representing data which might be obtained from smaller lamps at full loadings.

As shown in the table, when no ventilation was provided under conditions of full loading, surface temperatures of the luminaires reached 128 F. and the air surrounding the unit 126 F. With a ventilation rate of about 28 cfm per luminaire (roughly 4 cfm per 100 watts) surface temperatures dropped to about 110 F.

At higher temperatures, the lighting units performed as a source of radiant heat comparable to a panel heating system. Warmth could be felt even with a room temperature of 72 F.

Reducing the temperature as noted lowered the radiant effect to the point where some hundreds of people who have been exposed to this environment have found it entirely acceptable. At the same time, the illumination level obtainable actually increased from 335 to 385 fc.

It was interesting to see that, at 25 percent loading of the units, a heat transfer ratio of more than 70 percent was possible. This approaches the 76 percent figure of the heat theoretically available in the luminaire according to the example used previously. Light output under these conditions, however, was about 10 percent less than for lower exhaust rates, indicating that an approach to the maximum heat transfer rate may cause cooling of lamps below their optimum operating temperatures.

How Data Can Be Applied

As an indication of the practical application of this data, consider a multi-story office building lighted to about a 100 fc level. Current practice of some engineering firms calls for approximately 27 cfm of outdoor air per person to be introduced. It can be assumed that occupancy in this type of building is one person per 100 sq ft.

About one-third of the "waste air" would be utilized for exhaust through toilet rooms and to maintain a slight positive pressure within the building. The remaining 18 cfm per 100 sq ft of floor area is very nearly equal to the amount of exhaust air needed to carry out 40 percent of the excess lighting heat, using about 4 cfm per 100 watts through each luminaire.

That 40 percent reduction of heat gain employing the ventilation waste air to control the heat from lights means that the building cooling capacity figured to compensate for lighting load need be only 60 percent as great as would be required with a conventional system. Primary air handling equipment can be reduced proportionately.

It can be shown that an increase in lighting level from 50 to 100 fc for a typical office building using conventional techniques requires an increase of about 93 percent in the initial air conditioning equipment investment required for lighting, increases the total air conditioning budget, representing a total cost increase (initial plus operating expense) of about 18 percent.

With an integrated system, the initial cost of the additional cooling capacity required for twice as much lighting will be only about 57 percent higher, or 12½ percent of the total budget. This includes the cost of the extra air handling equipment needed to exhaust the luminaires.

At even higher illumination levels (above 100 fc), more luminaire exhaust air is needed than would ordinarily be made up from outside air. When outside temperatures and relative humidity are high, it may prove more economical to recirculate the luminaire exhaust through the cooling system.

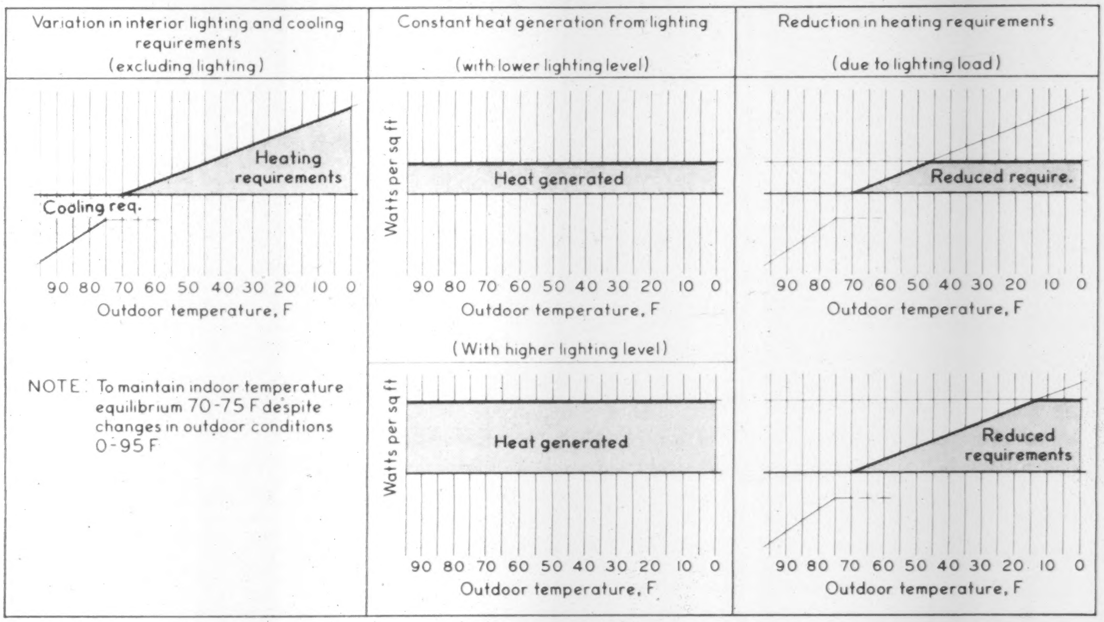
Mild weather may indicate the desirability of using a greater percentage of outside air, with an attendant "dumping" of luminaire exhaust and return air.

Many buildings have higher occupancy levels than that which we have considered, however, plus greater pollution incident, in which case normal requirements might call for up to 25 percent outside air introduction, or even more. Thus, the integrated system appears especially attractive for auditoriums, entertainment areas, high activity spaces, etc.

Saves Heating Costs, Too

The same integrated design which serves to reduce summer cooling requirements may also be employed to supplement the building's heating system when luminaire exhaust air is properly directed for recirculation.

The effect of an increased light-



2 INCREASED LIGHTING LEVELS have these effects on heating requirements. First panel shows effect of outside temperatures on heating-cooling requirements when constant interior temperature is maintained. Shaded areas of middle and right-hand panels indicate additional heat available from lower and higher lighting levels, with corresponding reduction in mechanical heating requirements

ing level on heating requirements is demonstrated in Fig. 2, in which the original abscissa represents a maintained inside temperature of 70 to 75 F. Proceeding to the right of the chart, the increased heating load due to lowering outside temperatures is represented by the rising temperature line for the air being supplied to the building.

Under low illumination level conditions, the heat generated by the lighting system eliminates a portion of the added heat required to compensate for increasing building losses. Obviously then, when a higher illumination level integrated system is employed, a greater percentage of heat loss is made up by the lights themselves.

The chart presupposes, of course, that the luminaire exhaust is carefully controlled and the heat from it re-introduced properly.

Returning to our "typical" multi-story office building, we find that a uniform lighting level of 100 fc over all parts of the building should supply enough heat to compensate for about two-thirds of the building's heat losses under outside conditions of zero F and 15 mph wind. A 150 fc system might equalize building heat losses, which could mean a substantial reduction in original and operating heating equipment expenses.

Advantages *vs* Costs

In summary, we must acknowledge the fact that higher illumination levels have been and will continue to be provided in industrial and commercial buildings. These levels are found to be both desirable and profitable to management in terms of better performance by the people they employ. They are economical despite the fact that increasing the illumination level calls for a corresponding increase in the air conditioning to take care of it.

Nevertheless, these are significant opportunities to capitalize on the thermal properties of light sources, using the lighting heat when it is needed to replace building heat losses and eliminating a substantial part of it when it is not needed. With the added benefits of better lamp and ballast performance and less lighting heat in the spaces occupied by people, the incentives for developing such "integrated" systems become very great.

Our modern buildings are much better buildings than those designed and constructed even as recently as 10 years ago. Better electrical and mechanical facilities are responsible for much of the improvement. However, we have arrived at a point where individual and isolated design of the various components of a building is unrealistic in terms of function and economics. One of the greatest opportunities for future improvements lies in better coordination of lighting and the mechanical facilities. ╪

In the lumber and plywood industry . . .

Good Piping Practice Pays Off

By WILLIAM D. LESHER
Consulting Mechanical Engineer

THE PLANTS operated by Georgia Pacific Corp. to accomplish the various steps in lumber, plywood, and pulp and paper product manufacture are many and diversified, and the engineering of the piping systems for these plants becomes quite involved.

Sawmills need plenty of compressed air, steam, and water. Plywood plants require, in addition to air, steam, and water, resin and chemical storage, as well as extensive glue loft facilities. Drying and humidification operations carried on at the various stages of raw and finished material treatment call for extensive humidity control facilities.

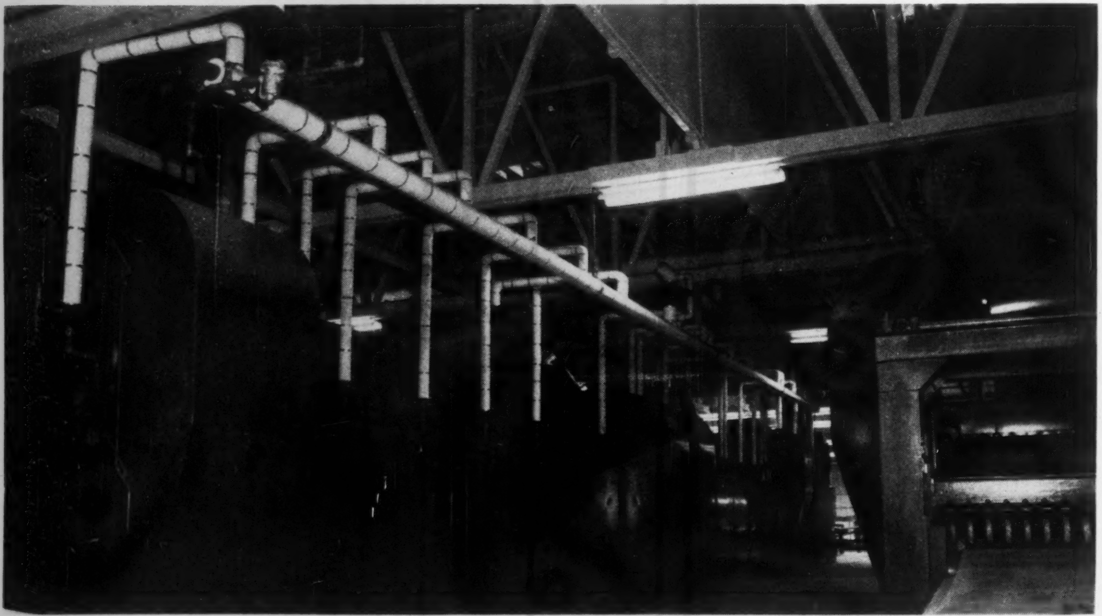
It has been quite common in the lumber and plywood industry to engage piping contractors on the job to install the various systems as best they can, rather as an afterthought to the overall planning for the plants, and without much idea of how much a completed system will eventually cost to own and operate.

We have found, in the course of constructing several new plants in northern California and Oregon, that the basic rules of good planning and engineering can be used along with new ideas culled from the experiences of other industries to effect real and substantial savings, and to insure good overall performance.

When piping is planned and engineered along with other features of a new plant, facilities such as trenches, pump houses, supports, and supporting structures can be incorporated into the overall design early enough to expedite completion of the whole project.

Helps Contractors, Too

Our practice of integrated planning and layout has meant that contractors have been enabled to compete intelligently and fairly for the large amount of work to be contracted. Moreover, on large projects, early planning allows us



PLYWOOD VENEER DRYER steam manifold installation illustrates use of good piping practices including location of branch take-offs on top of main, adequate trapping, appropriate drip points at steam header for each dryer

● Exhaustive planning in the design of piping services for new industrial plants can pay big dividends later on. Recently-built wood products plants owned and operated by Georgia Pacific Corp. in northern California and Oregon attest to this axiom. Georgia Pacific is a major forest product manufacturer in redwood lumber, plywood, hardboard, pulp and paper, container board and chemicals, and a producer of natural gas and coal. The special requirements in the manufacture of these products impose rugged demands on steam, water, compressed air, and other piping. How some of these systems were designed—always with an eye toward tomorrow's anticipated needs—is told in this article.

Mr. Lesher received his BS in chemical engineering from the University of Washington in 1942. After Navy duty during World War II he joined American Bimutuls and Asphalt Co. where, as an asphalt refinery plant engineer, he was responsible for new construction and maintenance. In 1952 he became associated with D. R. Seip Co. as design and project engineer. Two years later Mr. Lesher opened his own consulting engineering office. He is a registered professional engineer in Oregon and Washington and a member of NSPE.

to take advantage of carload prices on such things as pipe, valves, and fittings. It also lets us take time to check carefully with manufacturers to be sure that any item is selected with full knowledge of its specific intended design application.

The result is that not only does the completed system perform as intended, but wasteful use of materials is eliminated.

A Better Job . . . Easier

To illustrate how exhaustive and timely planning has helped us do a better job more easily, let's cite a major design problem:

In many of Georgia Pacific's plants, the boiler house is some distance away from the area of steam consumption. Very often, the steam main route presents a difficult problem at first appraisal. Discussions of the problems and the study of many preliminary layouts get the serious planning started. For example, at Springfield, Ore., a 10 in. steam main stretches across a straight line route 1100 ft long and is carried by a wood chip conveyor belt structure. Eventually, this line will transport steam at 250 psi.

We simplified the support and expansion compensation for this main by installing tied dual lateral deflection expansion joints. The basic advantage of this type of joint is its ability to absorb the end load due to the pressure within the joint itself, thus removing this force from the total anchor load. Thus, we needed to contend only with the lateral deflection force of the total joint when figuring the anchor load. This force is comparatively small, as are the forces transmitted to the structure.

With the removal of the end thrust forces on the pipeline, we no longer had to consider it as an axially loaded column which is so slender that a strong likelihood of bending or buckling exists. And, of course, the equipment at the terminal end of the main is not subject to any appreciable force due to expansion.

Return Condensate Direct

Plywood plant veneer dryers must operate under conditions of maximum heat transfer in order to attain the highest possible production rate. We have found it profitable to return high pressure condensate directly to the boilers serving such dryers.

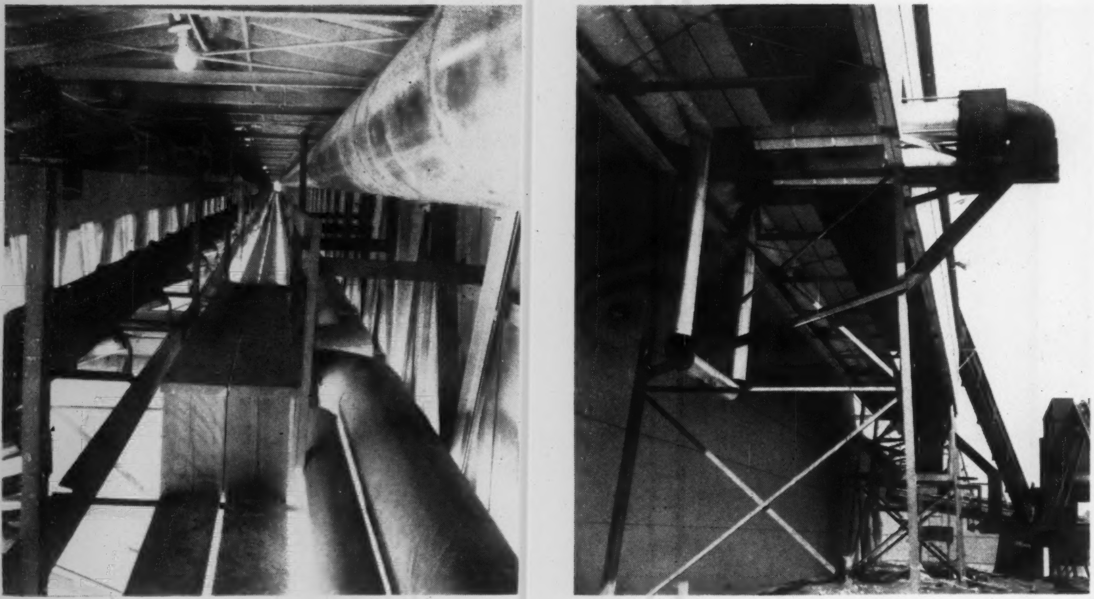
At the heart of such a system are high pressure condensate pumps of special design, the benefits of which are increased by using a system which allows the same pumps to return the low pressure condensate collected from hot presses, steam main drips, and various space heaters.

Basic, but often overlooked piping practices — such as appropriate drip points along the steam main, especially at the steam headers for each dryer, and the fact that branch takeoffs are located on top of the main — insure a dry steam supply throughout the plants.

Equipment Serves Doubly

This same practice of early and complete planning has enabled us to exact double duty from many installations without expensive later modifications. For instance, a compressed air main not only can serve the equipment for which it is installed, but when equipped with air outlet cocks and hose connections at convenient locations, will serve many other operations requiring a compressed air supply for entirely different purposes.

Hose connections on water mains are similarly scattered so that they can be used for washdowns and other purposes. We have followed the general practice of specifying



INSIDE VIEW of 1100 ft chip conveyor housing, at left, shows 10 in., 250 psi steam main supported by conveyor structure, paralleled by high pressure condensate return line, with hog fuel blow-pipe above. Looking back from outside housing, at right, tied dual-lateral expansion joint for steam main can be seen, with condensate return expansion joint below

black pipe for large air mains and using galvanized pipe for top branch connections. We take particular care to see that air mains and branches all drain toward a trap to remove water.

Proper layout and selection of materials for resin and chemical storage and glue loft facilities at plywood plants can increase the efficiency of operations considerably.

Resin storage at the Coos Bay, Ore., plywood plant is by means of vertical tanks, which afford greater ease of cooling with a sprinkler system, smaller space requirements, and a smaller amount of surface area exposed to the air (resulting in less "scum" which is a normal formation in such tanks).

We located these tanks on a concrete pad above the suction pumps and provided each with a bottom outlet which could be used to drain the tank completely should this become necessary. A similar arrangement might be used for storage of other viscous liquids — asphalt, for example. The piping for these tanks was arranged so that it could be easily disassembled for cleaning.

Choose Valves Carefully

In the selection of valves for use in glue and resin service, we looked for types that would offer little resistance to flow and which we expected would be reasonably troublefree in operation. Another requirement was that such valves provide for easy disassembly for cleaning.

Many good plug and ball valves suit these conditions. We have found that an eccentric plug valve offers several advantages, and in our case proved to be the most economical. Other types, however, will provide equally good service in some conditions and often turn out to be an equally good investment.

We recently undertook extensive modification of the Georgia Pacific hardboard plant in Coos Bay. A 100 ft long humidifier was provided with several zones of humidity control. The average condition within the enclosure was a dry bulb temperature of 140 F and 90 percent relative humidity.

Prior to modification, humidity sensing bulbs were located inside the humidifier housing, and as a result received very little attention. We found them covered with tar and inoperable.

We relocated the sensing bulbs to an outside position, and provided a scoop for each sensing zone of the humidifier to bring a continuous air sample to the bulbs and to return the sample to the humidifier housing. The bulbs can now be attended as they deserve.

We also reworked the instrumentation and piping connected with the humidifier and achieved better preparation of the steam with a more accurate quality control possibility, at the same time enhancing the ease of maintenance and simplifying the whole operation.

Such ease of maintenance, simple and correct operation, good appearance, and standardization of materials are the results for which we have aimed. ‡

FRED W. HEINOLD
JUNIOR HIGH SCHOOL
1959

Prefab Radiant Panels, Packaged Units Heat and Ventilate Six-Building Campus

By R. BURGETT
A. M. Kinney Associates
Architects & Engineers

THE FIRST campus-plan educational facility to be constructed in the Cincinnati, Ohio area, is a six building complex designed to accommodate 1400 students.

This is the Fred W. Heinold Junior High School, designed and engineered by A. M. Kinney Associates, architects and engineers. It has already been cited for excellence in planning and design by the American Association of School Administrators.

All six buildings on the campus are connected by covered walkways, and include two classroom buildings, a science center, an industrial arts building, an arts and crafts center, and a commons structure. With the exception of the last, all are of one story design. The commons building, located in the center of the campus, houses a gymnasium, auditorium, dining rooms, music facilities, and administrative office space. Then central heating plant is located at one end of the industrial arts building.

During the design stages of construction, both a central heating plant and individual equipment for each building were carefully considered. Investigation showed that a central hot water heating facility, designed on the basis of a larger than usual temperature drop, would be the more economical plan. Smaller distribution lines, with a consequent savings in initial cost, could be used with such a system.

As in all school construction projects, however, various requirements for adequate air changes and outside air supply had to be met.

Use Hot Water, Perimeter System

The final design incorporates a hot water radiant heating system supplemented by individual air handling units which serve to provide outside air to each building.

Such a combination affords the double advantage of occupying a minimum of floor space and the fulfillment of ventilation needs on a building-by-building basis.

The details of the design increase this advantage

• A unique combination of prefabricated radiant panels and individual heat exchanger-air handling units — both supplied by the same central hot water source — heats and ventilates a brand new six building junior high school campus in Cincinnati. The space-saving advantage of a central heating plant is enhanced by a design utilizing a 40 F temperature drop to permit smaller supply lines, suspended radiant panels which require no floor space, and the use of "waste" spaces above toilet areas to house ventilation equipment.

to a considerable extent. Radiant units installed within each room in the various buildings consist of one-piece copper sheets containing integral inflatable copper water channels built in to the sheet, or strips, and installed in sections. These radiant panels are installed, generally, below the roof deck and along the outside walls in order to offset perimeter heat loss. The copper tubing is continuous within each panel, adjacent runs being connected by a U-bend at the end of the sheet. Each sheet contains three water channels.

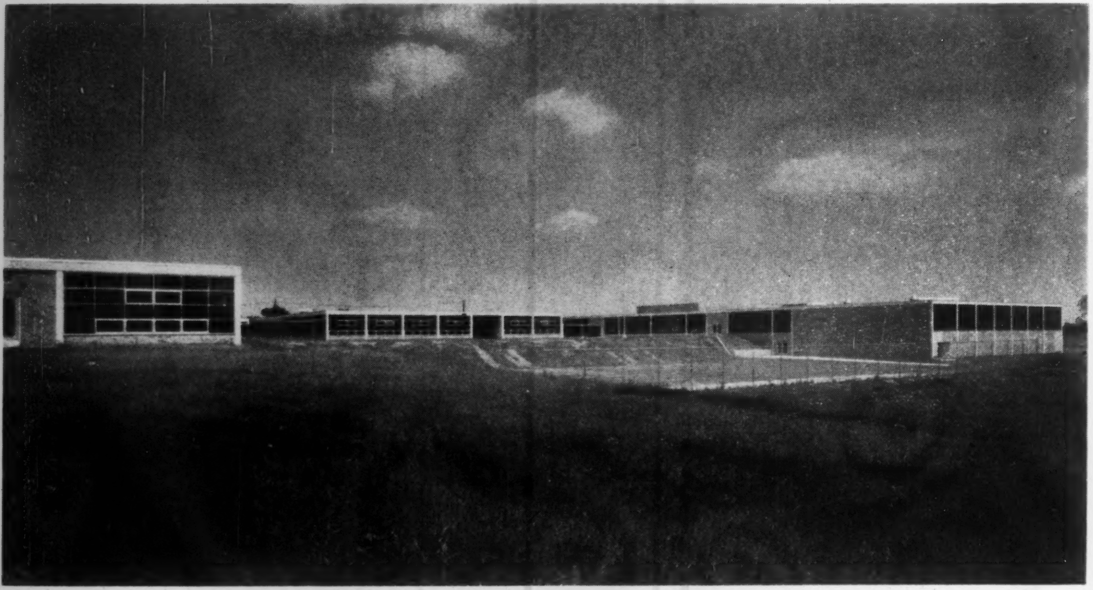
Packaged Units Supplement Radiant Panels

Supplemental air handling units for each building are located in otherwise unused spaces above the toilet areas and above suspended ceilings in hallways. These provide for the six air changes per hour required by local building codes.

By separating the ventilation system in this manner, the amount of mechanical equipment needed was reduced, maintenance will be easier, and little noise is added to the normal occupied room level.

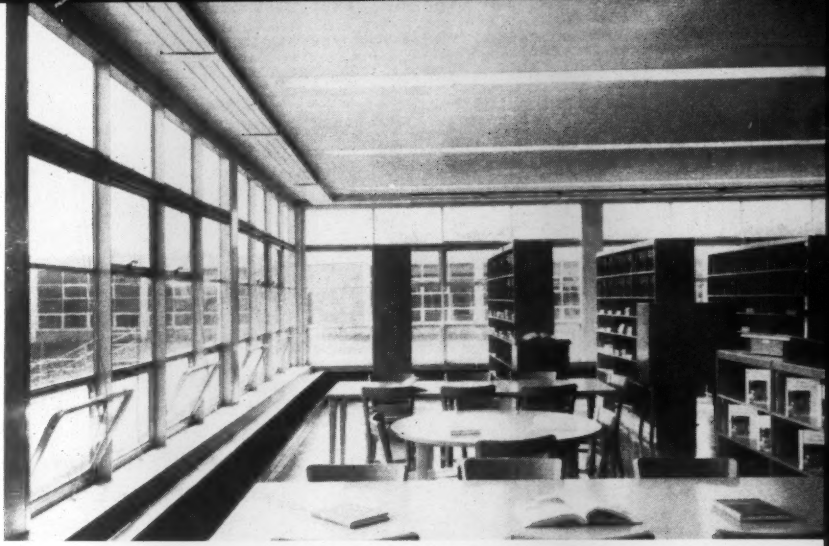
In most cases, radiant panels are located just below ceiling level, but in some areas such as music rooms, where roof trusses are exposed, both the radiant panels and ducts for the ventilation equipment are installed above the level of the suspended lighting fixtures.

Both the copper panels and the individual heaters are supplied by two gas fired boilers of horizontal fire tube construction. Each has a capacity of 3,350,000 Btu per hr, equal to approximately two-thirds of the maximum heating requirements. Thus, if an



SIX BUILDING school complex is constructed on one-story plan, uses central hot water heating system with unique prefabricated radiant panels plus supplemental packaged air handling units

TWO WAYS of utilizing prefabricated copper radiant panels are shown at right and below. Here, perimeter runs are installed below ceiling and light level in school library



emergency should force shut-down of one boiler, the other could carry the entire heating load except during periods of unusually cold weather. Each boiler has a flow rate of 160 gpm at an operating pressure of 50 psi.

At design conditions, water leaves the boiler at 280 F and returns at 210 F. This 40 degree temperature drop permits the smaller distribution lines mentioned earlier and also requires less pump horsepower.

Nitrogen System Maintains Pressure

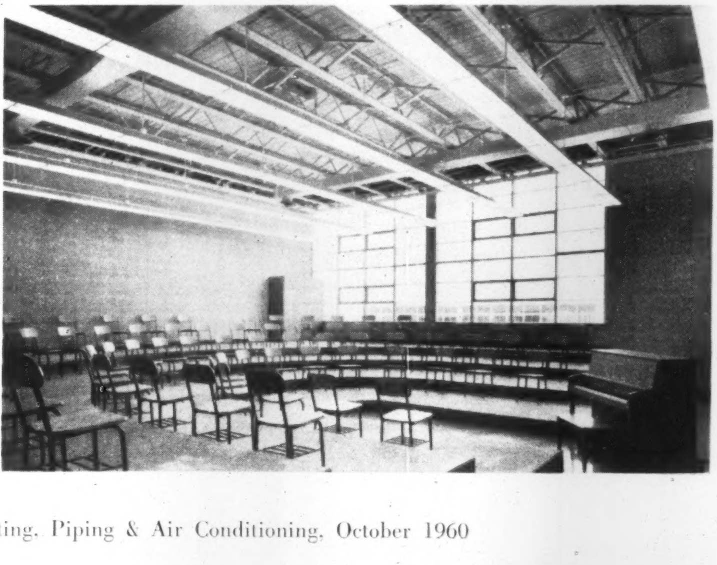
Horizontally suspended compression tanks provide for expansion in the system. Nitrogen introduced to the tanks maintains the required minimum pressure, and precludes the oxidation that would occur if air were used.

Circulating pumps are of the packless can-type in order to obtain maximum efficiency with a minimum of maintenance under designed operating temperatures and pressures. A hand-operated pump is provided for adding make-up water to the system.

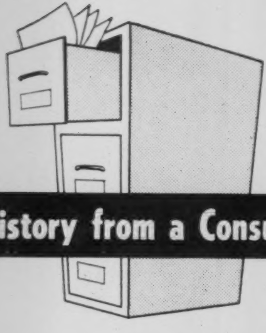
Black steel pipe supply lines installed in trenches between the buildings are linked with copper tubing lines to service the radiant panels. The trenches are located beneath walkways, and a granular fill insulation is used.

Temperatures in the classrooms are controlled by individual room thermostats which operate throttling valves in the supply lines to each panel. Hot water flow through the heat exchanger coils in the ventilating units is regulated in response to outside thermostats, so that the temperature of the supply air varies inversely with changes in outdoor temperature.

The E. J. Nolan Corp. was the mechanical contractor for the system. The editors acknowledge the cooperation of Revere Copper & Brass, Inc. in the preparation of this article and in providing photographs in which their copper Tube-In-Strip is shown. ‡



RADIANT PANELS for rooms with open-ceiling construction (left) are mounted along perimeter walls above suspended light level. Ducts connected to supplemental air handling units are installed inboard of the panels, furnish required ventilation through circular diffusers



Case History from a Consulting Engineer's Files

By C. T. BAKER
Consulting Engineer

Modern heating, piping, and air conditioning systems, for efficient and satisfactory operation, must be correctly designed. Here is a typical case from the author's experience where original design was faulty and had to be corrected.

• cooling tower must have air

A CERTAIN manufacturing company purchased an atmospheric spray type cooling tower to replace an old one that had out lived its usefulness. The new tower failed to supply condensing water at temperatures low enough to hold condensing pressures below 205 psig when the plant was operating at or near capacity. With the old tower, condensing pressures seldom exceeded 185 psig.

A check on the performance of the new tower disclosed some interesting facts. The performance guarantee for the new unit was based on 78 F wet bulb temperature. In actual operation, wet bulb temperatures surrounding the tower averaged 85 to 86 F.

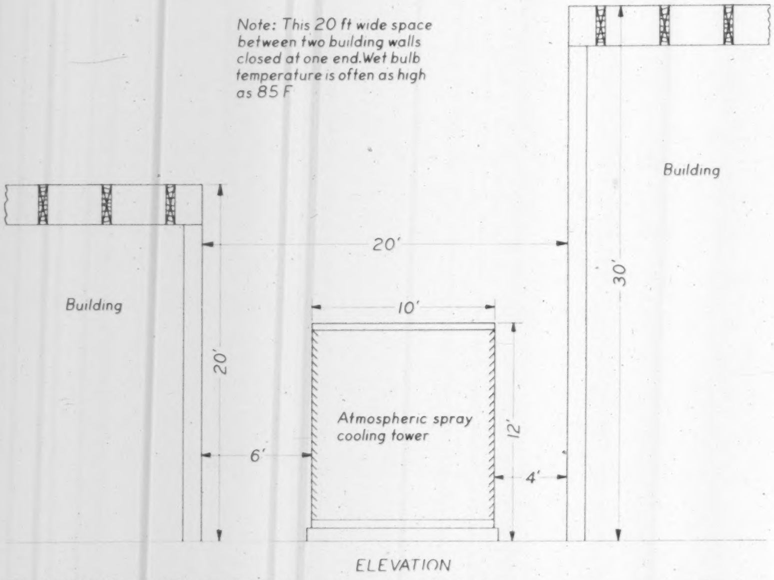
This high wet bulb condition was due to a mass of moisture laden air that enveloped the tower for a great portion of the time it was in operation. The accompanying sketch shows the reason for this condition.

Note that the tower is located between two high walls. One end of the opening between the two building walls was closed off. Under such conditions, it would not be logical to expect satisfactory overall performance.

Being closed in, there was little opportunity for air to ventilate the enclosure and carry the water vapors to the area above the two structures. When installing the new unit, the owners ignored the instructions of the manufacturer showing how to proceed with selection of the best location to insure good performance.

As an example of how this installation influenced power consumption, consider the following: With a suction pressure of 20 psig and a condensing pressure of 185 psig, the power required per ton of refrigeration was 1.3 bhp. For the same suction pressure and 205 psig condensing pressure, the power demand becomes 1.1 bhp per ton refrigeration — an increase of 7.7 percent. There is also considerable loss in plant output due to the increase in quantity of flash gas resulting from the 20 psig increase in condensing pressure.

Considerable improvement was made in the operation of the tower by installing a large exhaust fan above the unit to induce good circulation, removing much of the water vapors from the affected area. ⧺


Note: This 20 ft wide space between two building walls closed at one end. Wet bulb temperature is often as high as 85 F
Building
Building
20'
30'
10'
20'
Atmospheric spray cooling tower
12'
6'
4'
ELEVATION

ATMOSPHERIC SPRAY TYPE cooling tower failed to operate as expected when installed because adjoining walls prevented escape of water vapors

In new Medical-Dental building —

Three-Pipe System Gives Tenants Full Comfort Control

By ANTON KRAPEK
Vice President
E. Roger Hewitt Associates, Inc.
Professional Engineers

• Fan-coil units are used two ways — as year 'round air conditioners in exterior rooms and for air recirculation only in interior spaces — to provide individual room comfort control in the new Lansing, Mich., Medical-Dental building. Full cooperation between owner-occupants, architects, consulting engineers and the air conditioning contractor resulted in a building tailored expressly to the working and comfort requirements of each tenant. A three-pipe system is used for the building, with separate hot and chilled water lines connected to a thermostatically controlled three-way valve at each terminal unit, but with a single common return from all coils. The return line is split to a heat exchanger and absorption-type chiller on the discharge side of the circulation pump. A packaged air conditioner serves one windowless suite occupied by an eye doctor.

Mr. Krapek is a registered professional engineer in Michigan and Indiana and a member of several engineering societies and associations. He attended Alma (Mich.) College and is a graduate of Aeronautical University.

THREE YEARS of constant planning and extended effort on the part of doctor-owners, architects, engineers, and contractors has resulted at last in the new Lansing, Mich., Medical-Dental Building. This two story L-shaped structure is impressive not only in size but in the extent of the modern professional facilities which it offers.

The seven doctors originally involved in the basic planning were joined eventually by others, swelling the number of original tenants to 33. The site selected for the center was relatively central to the area served, but far enough from downtown congestion to make it convenient. The location grade was such that a true bi-level building was planned, with separate parking areas and

CURTAIN WALL with sill height masonry back-up provided continuous cavity used to conceal vertical ducts which extend from each fan-coil unit to horizontal louver beneath window sash. Hot and chilled water supply and common return lines are visible beneath floor grade

entrances for the upper and lower levels on opposite sides of the structure.

Because owners and occupants were the same, suite area requirements could be accurately determined and equipment spaces integrated in the floor plan. For example, necessary equipment is installed over permanent floor openings in some dental areas, so that new equipment can be brought in at some future time without the necessity for major renovation.

In addition to the normal doctor and dental facilities, the plans called for two cystoscopic rooms, an X-ray room, pharmacy suite, and a cobalt treatment room with 3 ft thick masonry walls. This last area will be placed in operation in the near future and is the only one of its kind in the city.

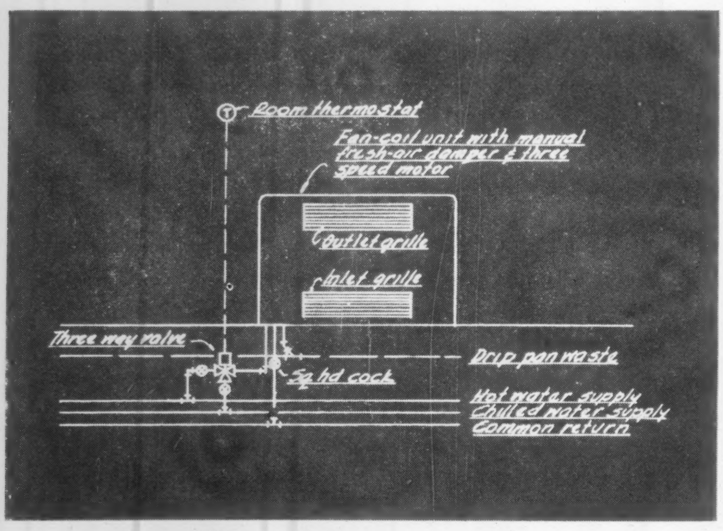
Our firm was engaged by the architects to furnish comfort engineering as the final floor plan began to take shape. Consultations with the building designers and occupants soon established the basic requirements for the year 'round air conditioning system.

Establish System Requisites

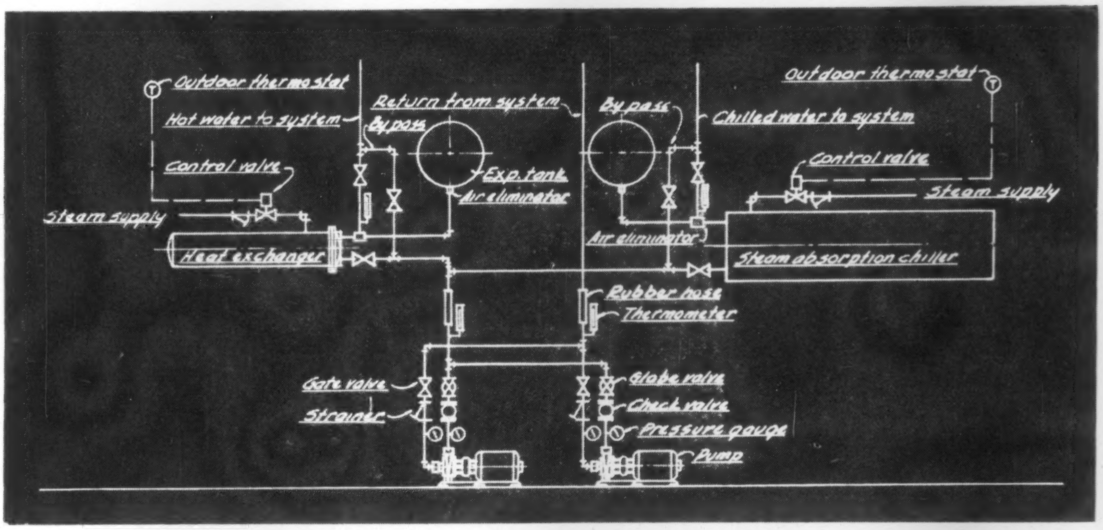
Individual room temperature control was a prime requisite. The system would have to be extremely quiet, since noise could interfere with the use of a stethoscope. Floor space was at a premium; therefore terminal units would have to be reasonably small. In addition, we wanted to avoid the large amount of ductwork that might be required with some systems. Finally, some areas would be relatively small, having been designed to fill specific needs in the most functional manner, further accenting the need to restrict the amount of floor space used.

The air conditioning system ultimately conceived would utilize compactly designed fan-coil units with multi-speed motors. While the noise level attained with the fans at high speed might be somewhat excessive, these could be easily set at low speed when a stethoscope was to be used.

Heating was to be provided through a system of forced hot water circulation, and cooling by means of circulating chilled water through the same two-pipe system. However, it was readily apparent that even with pump zoning we could not hope to satisfy temperature control requirements for



FAN-COIL UNIT PIPING incorporates hot and chilled water lines connected to three-way valve, from which single run-out extends to coil. Water then passes to common return



THREE-PIPE SYSTEM uses steam boiler, steam-to-water heat exchanger, steam absorption chiller. Mixed water in common return is split on discharge side of circulating pump to heat exchanger and chiller

each tenant at all times. Mild weather conditions often demand cooling in one portion of a building while another portion still demands heat.

Consider Three-Pipe System

At this point we began to consider seriously the three pipe system finally selected. Basically the resultant system as designed is a modification of the two-pipe reverse return principle. However, instead of circulating hot water through the supply and return piping when heating is required and then changing valves to circulate chilled water when cooling is required the three-pipe system circulates chilled water supply through one main, hot water through another and uses a return common to both. One pump in a duplex stand-by arrangement is used to provide the circulation of all water through all mains.

Outside air is provided by 129 fan-coil units in the exterior walls of the building. 121 similar units are used for recirculation only in interior rooms.

These interior areas are provided with a system of exhaust air ducts, each floor being served by belt driven centrifugal fans. Exhaust air is drawn from the exterior areas into and through interior rooms; thereby providing a sufficient air change to prevent stagnation.

One of the lower suites developed into a natural for an eye specialist in that it was partially below grade. Since careful eye examination demands total darkness the exterior wall was designed without windows. This factor, though an advantage to the occupant, became quite troublesome in the mechanical design since outdoor air could not be provided to the fan-coil units in the normal way. In this case, fan-coil units were still employed, but were used for recirculation only. Conditioned outside air is introduced into each room through ceiling diffusers, supplied from a ceiling mounted heating and air conditioning unit located in the boiler room.

A single outside air louver in the boiler room wall is connected by a duct to the unit and also provides combustion and ventilating air to the boiler room proper.

Use Three-Way Valves

Each fan-coil unit and the boiler room unit is provided with a three-way valve. Runouts from the chilled and hot water mains enter this valve and a single runout extends to each unit. After passing through the coil, the water enters the common return main. A single acting pneumatic thermostat controls the operation of each three-way valve.

As the temperature rises, the thermostat closes to the hot water side of the valve and opens to the chilled water side. A drop in temperature allows the valve to open slightly on the hot water side to provide a blend of supply water to the coil. A continued or prolonged drop closes the chilled water side entirely and again provides full heating.

Steam Boiler Installed

Hot water is supplied to the system by means of a gas fired low pressure steam boiler and a steam-to-water heat exchanger. Steam supply to the exchanger is controlled by an automatic valve, the operation of which is governed by indoor-outdoor thermostats. Heating water temperatures vary from 90 to 140 F, depending upon weather conditions.

Chilled water is supplied to the system through a steam absorption unit. Here, too, the steam supply is controlled with indoor-outdoor thermostats. In this case water temperatures vary from 45 to 50 F.

Although steam is required for the operation of both the heat exchanger and the chiller, the boiler was sized to serve only the capacity of the larger unit. Obviously, as exchanger loads increase, chiller loads decrease and boiler load is utilized accordingly.

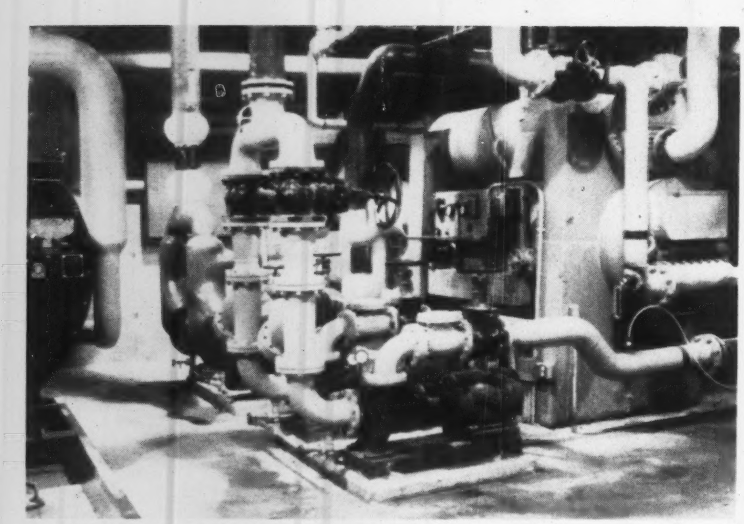
The same conditions prevail within the return main. When slight heating is required low temperature hot water enters the return main and tends to increase the temperature of what would then be primarily chilled water return. However, since some heating is still required in small areas of the building the amount of cooling, temperature-wise is still slight. Under such circumstances, the chiller has ample capacity to offset this additional rise.

The same is true in regard to the operation of the heat exchanger when conditions are reversed. Under extreme conditions when full heating or cooling is desired, the exchanger or chiller may be valved out of the piping system and water flow rerouted through bypass piping.

Return Main Split

After passing through the single pump, the return main splits and extends into the exchanger and chiller. After the water is heated or chilled it once again progresses in its respective main throughout the building.

A packaged cooling tower provides 400 gpm of condensing water to the 100 ton absorption machine through a duplex pump arrangement. Here again the second pump was provided as a stand-by to permit continued operation in the event of breakdown. The condensing water inlet to the tower spray heads was provided with a 1 in. globe valve bleed off line. A constant bleed off permits entrance of fresh make-up water into the tower reservoir eliminating the possibility of contaminant concentration through dilution. As in most instances, the tower required roof installation, but the architects decided the unit could easily be enclosed with a series of aluminum louvers in keeping with the design of the building. These were designed to also conceal the exhaust fans from view.



EQUIPMENT ROOM contains steam boiler at left, condensing water pumps in foreground, backed by hot and chilled water pumps and absorption machine

Use Louver for Air Intakes

Part of the exterior walls were to utilize curtain wall construction with sill height masonry back-up. Curtain wall piercing by the manufacturer is quite difficult, especially when the openings are small and demand accuracy in their location. In this project, wall openings were required for fan-coil unit outdoor air intake. Since masonry back-up would be employed, it was suggested that a cavity could be created between the back-up and curtain wall. This cavity was then used to conceal vertical ducts that extend up to a continuous louver which the architects cleverly integrated into the curtain wall directly below the sash. Those louver areas not used for duct connections were blanked off and insulated.

All concealed valves are accessible through access panels and each bank of valves is appropriately tagged noting the areas they serve. Major valves are noted by schedule, with each location and purpose given. Where control valves are located above the radiation-protection ceiling of the cobalt room, floor access panels were installed in the rooms above.

Lower level fan-coil units located on exterior walls are served by a pipe tunnel. Interior room units on both levels are served from a single series of mains which are concealed above the corridor ceiling. During the installation of heating and cooling water mains, oversized hangers were used and the mains were blocked up temporarily with wood wedges. As soon as a run of piping was completed, metal clad covering was installed and the hangers tightened into place. This method eliminated the possibility of condensation forming on the hangers since there was no physical contact between them and the piping.

Architects for the project were Mayotte & Webb; heating, piping and air conditioning systems were installed by J. A. Dart Co., and engineering consultants were E. Roger Hewitt Associates, Inc. ∓

NDHA Committees Report What's New

National District Heating Association technical committees report progress at 51st annual convention. Included among the topics discussed here:

- ***Growth of air conditioning loads***
- ***Campus heating methods***
- ***Welded stack failures***
- ***Steam meter development***
- ***Steam distribution problems***

AT THE RECENT 51st annual meeting of the National District Heating Association, technical committees of the organization reported the progress being made on investigations of many phases of district heating. The meeting was held in Asheville, N.C. (Previous reports on the meeting appeared in the August and September issues.)

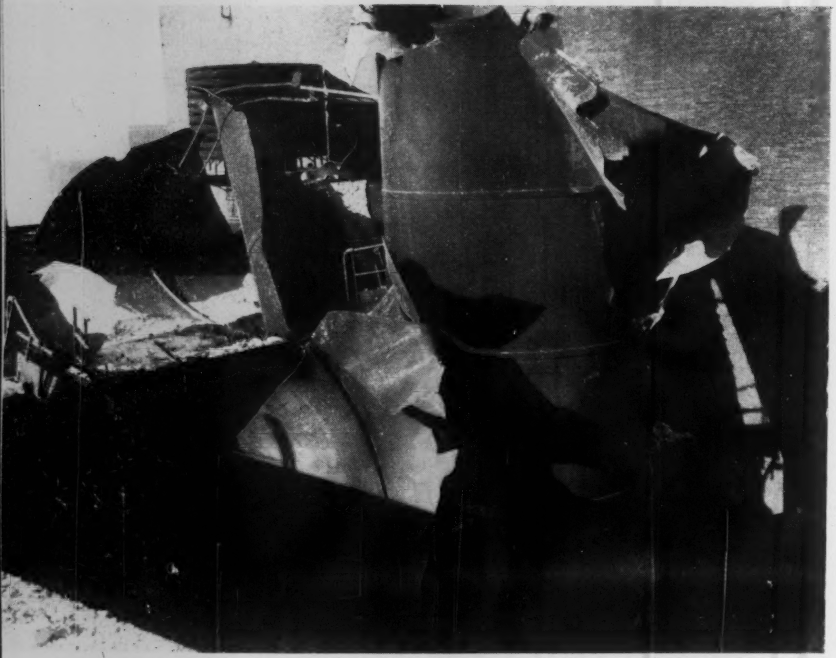
Panel Probes Cooling Loads

The program of the air conditioning committee, under the leadership of E. C. Bruce, manager, steam sales, Consolidated Edison Co. of New York, Inc., opened with a panel discussion on methods employed in obtaining air-conditioning loads. His panelists were Patrick R. Dwyer steam sales department, The Detroit Edison Co.; James W. Megley, load research engineer of Boston Edison Co. and committee chairman.

Mr. Dwyer said that an important factor in the growth of steam absorption in Detroit is the code requirement that a licensed operator be employed with compression type machines where horsepower is above 125 (in hospitals, above 25). Such an operator is not needed with absorption equipment, he reported.

Nine out of 10 installations are for customers on the advantageous demand steam rate. Promotion is through architects and engineers. The paper included a tabulation comparing the cost per year of operating an electric system and a central steam absorption system of equal capacity.

Mr. Megley stated that four years ago a steam rate for air conditioning had been made available and publicized in Boston when it was determined that such a rate was advantageous to both the customer and the company. The utility has available for the



WELDED STACK FAILURES like this can be prevented by taking material samples to determine loss of ductility at minimum temperatures

consultant such data as load factors, rate applications, climatic conditions, construction costs, etc.

Campus Interest Growing

Because of its ever-increasing activity, the campus heating committee, led by its chairman Thomas B. Kneen, utilities engineer concerned with physical plant planning and construction at Pennsylvania State University, is drawing more attention to its program. Next year's assigned period for the report will be an entire morning.

This year the group program included two papers and a panel discussion. The first paper, *Hot Water vs Steam for Space Heating Campus Buildings*, was summarized by its author, Samuel W. Miller, Jr., chief development engineer for John J. Nesbitt, Inc.

Mr. Miller's conclusion was that forced hot water is rapidly replacing steam as a medium for heating campus buildings. When properly designed, a hot water system can provide greater comfort at a reduced first cost and operating cost, he said.

In his second paper of the session, Mr. Kuhen reported how six universities are using heat driven absorption refrigeration machines to obtain year 'round control of indoor environment, more efficient power plant operation, greater electrical generating capacity, and the lowest per-unit cost for power produced.

Meter Campus Steam Flow

The subject of the panel discussion was the *Development and Use of Campus Heating Plant Records*. Richard G. Karch, superintendent, division of utilities and properties at Cornell University, participated in the discussion with Mr. Kneen.

Mr. Karch said that it was quite convenient for budgetary and other purposes in this period of rapid expansion of college buildings to have available operating statistics on steam use and maximum demands. He reported that laboratory bulidings average \$0.15 per sq ft to heat, classroom buildings \$0.075 and libraries \$0.05. Buildings built 40 to 50 years ago average \$0.07 to \$0.10 per sq ft, compared to \$0.13 to \$0.16 per sq ft for new ones with large window areas.

Universities are interested in measuring steam flow to various buildings and departments — just as utilities are in metering steam to customers. Chairman Kneen described the method of determining steam rates at Penn State, where steam is metered at every building on the campus. Budgets are estimated for the various areas. The 1958-59 steam rate was \$0.74 per M lb.

Improve System Load Factor

The commercial relations committee, chairmanned by Carl B. Sprenger, supervising engineer, customers service, The Detroit Edison Co., had two papers for presentation. In the first, Arthur T. Lukens, supervisor of the sales applications department of Philadelphia Electric Co., described the use of steam demand limiters by his company and discussed the effect they have on improving the system load factor in comparison with the influence of the demand provisions in the steam rate.

Mr. Lukens concluded that the customers watch their demands carefully, keeping them to a minimum either by manual operation or automatic means. The result is the high system load factor enjoyed by the utility—35.8 percent in 1959.

In the committee's second paper, the late Wilbur H. Ambrose, technician, The Detroit Edison Co., described a new method of regulating the temperature of domestic water from an instantaneous steam heater. This was designed to meet a new city code in an econmical way. Only standard specialty parts are used.

Report Sales Efforts

The sales development committee, under the active leadership of Mr. Lukens, presented three papers besides its new business report summarized in the August issue.

In the first of these, John A. Leo, research engineer, rate division, The Detroit Edison Co., talked on *Financial and Economic Targets Develop a Steam Main Extension Policy*. Mr. Leo discussed such factors as plant turnover ratio, operating ratio, fixed charge rate, percent of return, taxes of various kinds, depreciation, operating expense, load factor, development of normal steam main extension policy, special extension policy, and deposits in aid of construction.

He said improvements can be made by:

1) Expanding revenue and sales volume
2) Reducing the operating ratio
3) Improving the system load factor
4) Increasing rates.

Mr. Leo also covered the plan of his company to supply steam to industrial customers from the older electric generating stations now used as standby and peaking plants. He said that, in Detroit, industrial high-pressure steam is now being sold to 12 customers from three stations. The total annual sales of 3,240,000 M lb bring a revenue of $2,348,000.

In the second sales paper, Edwin F. McCarrick, sales engineer, steam sales bureau, Consolidated Edison Co., Inc. of New York City commented on steam sales in that city. He said that, today, builders of office buildings in New York City would no more think of installing a boiler plant than they would think of drilling a well for their water supply.

Builders of apartment buildings do not universally share this opinion, he said, but showed that, of 77 apartment houses erected during 1954 to 1958, a total 64 (83 percent) having 75 percent of the total volume took steam service. Mr. McCarrick pointed out that an office building bringing in $19,000 per year revenue would bring in $28,000 if it were an apartment building, and the load factor would rise from 23 percent to 38 percent, an indication of the desirability of selling the latter.

The final paper on the sales development program carried the intriguing title *To Market, to Market*, and was presented by Frank C. Shermer, manager, sales applications department, Philadelphia Electric Co. Mr. Shermer said the entire company, especially management, engineering, operating, accounting, and sales, has a part in the sale of steam and other services. He gave examples of successful sales in his home area involving the various departments.

Study Metallurgical Problems

One of several papers of the research committee, headed by Robert H. Swoyer, mechanical research engineer, Pennsylvania Power & Light Co., which was received with the greatest enthusiasm was the one entitled *Metallurgical Studies of Stoker Castings and Welded Stacks*, by William M. Dull, staff engineer, central heating department, The Detroit Edison Co., and I. A. Rohrig of the same company.

As the title indicates, this paper has two distinct parts—one concerning the deterioration of underfeed stoker nose plate castings due to high temperatures and the other the failure of welded steel stacks due to low temperatures.

The casting failures, they reported, resulted in frequent replacements and expensive outages. Experiments were conducted on an operating stoker by placing castings composed of different materials near to each other. In this way the material with the longest life was determined.

Samples were taken from the stack of an existing plant and subjected to tests at various low temperatures to determine the loss of ductility. In this way the minimum temperature below which brittle fracture of the stack may occur was found. Stacks will never be allowed to go below this temperature in the future, they said.

Stress Good Maintenance

The authors of the second research committee paper, J. P. Engle, C. E. Fox and R. B. Rosene, Dowell Div. of Dow Chemical Co., pointed out that for maximum efficiency certain maintenance should be on a definite periodic basis. Inefficient operation is a distinct economic loss. Extended operation at steadily decreasing efficiency is false economy. Manual cleaning requiring dismantling is too slow and costly. A competent chemical cleaning service is best.

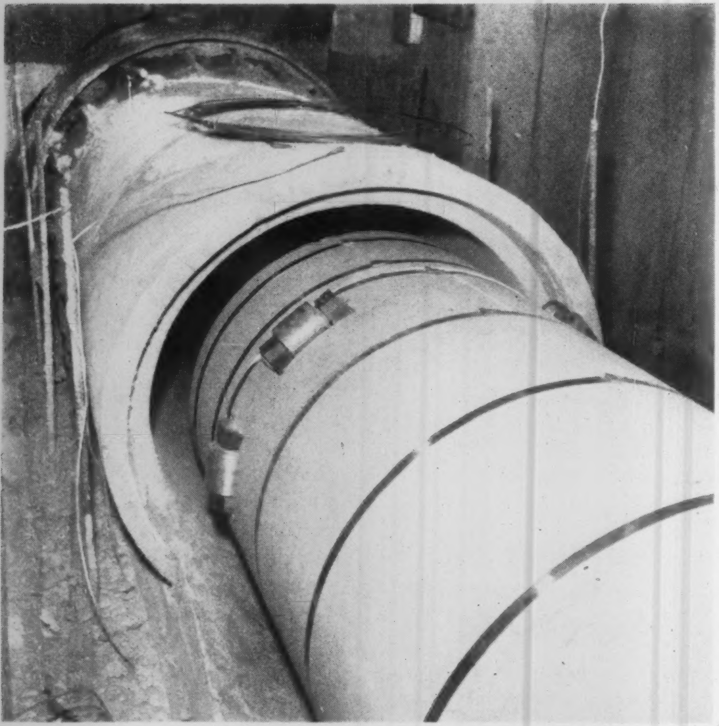
The practices of 37 steam utilities as to processing of makeup water used in 341 boilers was reported by Dr. S. F. Whirl, chemical operating engineer of the Duquesne Light Co. and its subsidiary, Allegheny County Steam Heating Co. in Pittsburgh.

Water purification methods vary, he said. Raw water source, makeup requirements, steam purity demands and costs are factors considered. Simplified methods with inferior quality may be entirely satisfactory for low pressure boilers, but not for high pressure, high makeup systems.

New Meter Testing Method

The metering committee, of which Victor J. Bliemeister, general superintendent of meter shops of The Detroit Edison Co., is chairman, delivered three interesting papers.

Charles E. Brown, Georgia Power Co., reported a new method of testing condensate meters.



INSULATED STEAM LINE ready for covering and insertion in conduit, runs 4500 ft to University of Pennsylvania campus, tunnels beneath Schuylkill river and 6-track railroad line. Steam is delivered through this pipeline at the rate of 500,000 lb per hr and at 200 psi and 450 F

His organization was concerned with the reason for using a rotating start and stop test in preference to a standing start and stop test. A time-and-motion study was made on an "E"-meter with the aid of a motion picture camera and a stop watch. It was determined that a test will be subject to less error at the start and finish if the drum is rotating.

Kenneth S. Davidson, Air-Conditioning Equipment Corp., presented a report on *Btu Metering for Central Heating and Cooling* in which he championed the need for individual Btu metering in central heating and cooling, principally in its applications in apartment developments, industry, municipal central heating, shopping centers, and air terminals.

In another outstanding paper, James W. Althouse, Jr., assistant superintendent of the meter division of Philadelphia Electric Co., developed equations concerning the theory of operation of turbine type steam meters. Also, several alternate methods are set forth, in detail, for testing them with air.

As the result of tests, the author suggested needed improvements in design.

Outline System Development

The final report was that of the distribution committee, headed by James A. Sheppard, Jr., assistant engineer, Consolidated Edison Company of New York, Inc. Mr. Sheppard's report included four papers.

William J. Ryan, Jr. of the Boston Edison Co. outlined analog methods used by his organization in system development studies, and a digital method proposed. He evaluated such methods briefly.

Then, Howard C. Goellner, general superintendent, steam heating production bureau, Consolidated Edison Company of New York, Inc., described the steam distribution system in Manhattan and its load characteristics. He gave methods of forecasting and distributing steam loads.

There are 61 miles of steam lines from the Battery to 92nd Street. These deliver steam from six steam plants, three electric-generating stations, and other minor sources to 2354 customers. Feeder mains are primarily 24 in., distribution arteries are 20 in. and 16 in., and tie lines 12 in. and smaller. Two feeder mains connect the uptown and downtown districts; One operates on 400 psi, all others at 200 psi or less and convey dry saturated steam.

Robert A. Vance, senior engineer, engineering design department, The Detroit Edison Co., described the mile-long, 12 in. industrial steam line recently erected across the Semet Solvay property and the River Rouge from the Delray Power Plant of the company to the Zug Island plant of the Great Lakes Steel Corp.

The line is surrounded by 3 in. of insulation and is encased in a 26 in. diameter steel pipe. It supplies steam at 420 psi and 700 degrees F to Great Lakes Steel. Surplus blast furnace gas produced at Great Lakes is transported in large diameter pipes to Detroit Edison.

Steam Line Crosses River

In 1959 the Philadelphia Electric Co. installed a 20 and 16 in. line from its Schuylkill generating station to the University of Pennsylvania campus, a distance of 4500 ft involving a crossing of the Schuylkill River in tunnel and under a Pennsylvania Railroad six-track right-of-way. In his paper Ellwood A. Clymer, Jr., company engineer, described these two difficult problems.

The line is designed to supply 500,000 lb per hr of steam at 200 psi and 450 F maximum. ⌗

Return Air Reheat System Rights Others' Computer Cooling Wrongs

BY LEROY E. VARNER
Manager
Engineering Div.
Penn Mutual Life Insurance Co.

• **Profiting from the mistakes made by others on similar installations, Penn Mutual Life Insurance Co.'s engineering division designed the air conditioning system for its data processing center on the principle of using return air for reheat through a multi-zone air handling unit. The cold, drafty conditions common to those other systems are eliminated, and worker morale and efficiency are high.**

AIR CONDITIONING for a data processing center is difficult to design because the amount of heat emitted from the equipment, together with the light load, people load, and space load, requires a total air supply equivalent to several times that required for normal comfort cooling.

In addition, most present specifications for these centers call for an internal design condition of 75 F and 50 percent relative humidity, together with an air purity of 90 percent.

To accomplish this for our own installation at Penn Mutual Life Insurance Co., we tentatively decided to use three water chillers, each with a capacity of one-half of the total load of the system; two chilled water pumps, two condenser water pumps, the necessary interconnecting piping, one air handling unit with ceiling distribution, electrostatic filters, and four zones with duct reheaters.

Because the system would operate 12 months of the year, our tentative plan included an interior cooling tower using toilet exhaust air as a cooling medium.

With regard to zoning, the equipment would be installed in groups, each group being identified with its particular function. Since a single group or any combination of groups might be operating at one time, each group would be a zone insofar as air conditioning is concerned. Obviously, if all the equipment is energized all the time, there is no need for zoning.

This tentative plan we believed would meet the requirements for reliability by providing a spare water chiller, condenser, and chilled water pumps and would maintain the desired conditions with minimum draft. To accomplish this, however, in the original design the ceiling area was almost filled with ductwork.

Inspect Other Installations

In visiting and inspecting 15 offices having similar installations, we found a wide variety of systems. Approximately one-quarter of the total used electrostatic filters; the remainder mechanical filters of various types. Likewise, several types of humidification were found. One design incorporated two air handling units with provision for the use of 100 percent outside air. In several designs the underfloor space was used as a plenum for supply air to floor registers in conjunction with an overhead supply.

In these designs, some systems used one air handling unit for air supplied under the floor and one for the ceiling. In others, one air handling unit was used for both under the floor and the ceiling. In some cases the inner ceiling space above a hung ceiling was used as a return air plenum; in other cases air was returned by way of a duct system.

With the exception of two installations, the spaces were noticeably drafty. A notable example was a new installation which had been placed in operation two months prior to our visit.

Air Conditioning "Awful"

Operating personnel stated that the air conditioning here was "just plain awful." They said it was "too cold and drafty"; that "everyone was complaining." Some of the personnel were threatening to quit if they could not be transferred, and there had been an extremely high rate of absenteeism because of colds and sinus infections. In this installation, air at 55 F saturated was supplied both under the floor and overhead.

With regard to zoning and reheat we again found a wide variety of designs, from 11 zones with reheat in each zone, to one zone with reheat, to no zone control and no reheat. From the standpoint of controls, the conditions were similar.

It is interesting to note that in each case, regardless of the wide difference in design or method of installation, data processing equipment, so far as could be determined, was working satisfactorily.

Tentative Plans Altered

Our final air conditioning plans were completely changed. Remember that in our original design we specified one air handling unit with ceiling air distribution, three water chillers, two condensers, and chilled water pumps with four zones of control, duct reheaters, and electrostatic filters.

In the new design we use three water chillers, each with a capacity slightly in excess of one-half of the total load of the system, three chilled water pumps, two condenser water pumps, and an internal cooling tower which uses toilet exhaust air as a cooling medium.

Change Air Supply System

We completely changed our air distribution system, using the space between a raised floor and the original floor as a plenum chamber and supplying approximately 60 percent of the total air required under the floor using this space as a plenum chamber.

Air to satisfy the requirements of the high heat producing units is admitted to the space immediately under the machines and the return air for the entire space is taken from return air grilles above the high heat producing units, using the space above the ceiling as a return air plenum.

To satisfactorily accomplish this design, we use two air handling units; one for under the floor and one for overhead. The reason for this design was that we learned through the experience of others that air supplied to the under floor plenum had to be maintained at a different temperature and relative humidity than the air supplied overhead.

With regard to the difference in the conditions of the air supplied overhead and under the floor, with a proper design and proper diffusion it is possible to place air overhead at 55 F saturated without experiencing discomfort within the space.

We finally concluded, however, after many discussions and inspections that air could not be supplied under the floor under these conditions without creating some discomfort. We therefore designed the underfloor plenum air system to supply air at 65 F and approximately 70 percent RH.

With regard to zoned control within the space, you will recall that originally we planned to use four zones with duct reheaters. In the new design we use one zone for under the floor and reheat with return air bypassed around the cooling coil. In the overhead system we use four zones and reheat with return air using a multi-zone air handling unit.

We use a fixed supply of outdoor air placing a steam heating coil and a cooling coil in the outdoor air supply duct. Filtration is accomplished with an electrostatic filter. Humidity control is maintained with a steam grid-type humidifier placed in the overhead air handling system. Outdoor air is likewise admitted to the system through the overhead air handling unit.

"One of the First"

To our knowledge this is one of the first air conditioning designs for a data processing center to use return air for reheat through a multi-zone air handling unit.

From the time the system was started to the present we have had no complaints from personnel within the space and under questioning they have repeatedly stated their satisfaction.

From the standpoint of drafts, the system is functioning better than we anticipated.

The conditioned air for the machine load is supplied from below using the under floor space as a plenum. The design conditions of 65 F and 70 percent relative humidity have been entirely satisfactory.

The conditioned air for space cooling is supplied through insulated ducts in the ceiling return air plenum. The design for this system under maximum load was 55 F, saturated. For less than maximum load conditions, the system reheats with return air to provide 75 F and 50 percent RH. Under actual operating conditions it was found that the personnel preferred 72 F and 50 percent RH, and this adjustment has been made.

Add Outdoor Air

For obvious reasons outdoor air and humidification are added in the overheated air handling unit. To produce a satisfactory temperature for bypass air in zones calling for no refrigeration, the incoming outdoor air is first chilled to 55 F to remove the moisture and is reheated to 80 F. With the complete elimination of the machine load in any zone, we experience over cooling by approximately 2 F due to the under floor system. This is not objectionable, and has not been a problem.

By using the floor as a supply air plenum and the ceiling as a return air plenum, with a metal pan snap-in ceiling and return air snap-in registers, we believe the flexibility is about the best attainable.

During off periods with no machine load, the under floor system is shut off and the overhead system is operated to "maintain" the space conditions, and this arrangement has been found to be very satisfactory.

This was our first experience with the use of multi-zone air handling units using face and bypass dampers. We found by experience that under no load conditions (100 percent bypass air) we add to the refrigeration load to some degree. This, however, has not caused difficulty. ‡

This article is based on a paper presented by Mr. Varner at a recent conference sponsored by the National Association of Building Owners and Managers. The original paper appeared in the April 1960 issue of Skyscraper Management. *Additional information based upon operating experiences during the past summer has been included.*

GROUND WATER FOR INDUSTRY

How Underground Reservoirs Provide Cool Water for Industrial Uses

> "We never know the worth of water till the well is dry."
> THOMAS FULLER

● Water plays a vital role in almost every industry and in practically every way of living. A thousand gallons of water a minute at a temperature of 50 F can provide about 300 tons of refrigeration for air conditioning, a water supply for a town of about 10,000 people, and can cover an acre of farmland with 4 in. of water in a day.

Although water can be obtained from either above or below land surface, the convenience of an almost unending supply of water at a comparatively low and constant temperature makes ground water increasingly desirable as a water supply. Moreover, nature delivers it to the site without charge. History has shown that a good ground water supply can mean the difference between economic success and failure in an industry or community.

This article, the first of a series concerning ground water, discusses the ground water reservoir — its structure and the water contained therein. Subsequent articles concern the hydraulics of ground water movement, especially in the vicinity of wells; wells and well drilling; pumps and pumping equipment; ground water chemistry and corrosion; and ground water problems.

By JOHN F. HOFFMAN
Director of Research and Development
Griffin Wellpoint Corp.

ALTHOUGH consolidated rock is present at depth everywhere, the material of concern in the ground water reservoir lies within a depth that can be economically tapped by wells. Sometimes water from shallow depths is not satisfactory either in quantity or quality and water must be obtained at great depth. For example, in some areas of the Southwest, wells must be drilled to a depth of 1000 ft before a suitable supply of irrigation water is obtained. On the other hand, in many places along the Eastern Seaboard, such as in eastern Long Island, the depth to water is less than 5 ft, and pits dug by cranes yield water supplies in excess of 500 gpm.

Ground water, like surface water, is stored in a reservoir. Generally speaking, ground water reservoirs can be divided into two broad categories: (1) those composed of unconsolidated rock and (2) those

GROUND WATER FOR INDUSTRY

composed of consolidated rock. Structural aspects of various ground water reservoirs are shown in Fig. 1.

Contrary to popular usage, both rock and unconsolidated material (such as sand) are geologically termed rock. This terminology will be used throughout this series of articles.

Unconsolidated and consolidated ground water reservoirs can be subdivided into component parts on a water-yielding basis. These component parts are aquifers and aquicludes.

An *aquifer*, a term that will be used frequently throughout this series of articles, is a water-bearing body that yields and transmits its water readily. Its thickness and extent may be extremely variable. A number of aquifers may underlie a site, depending upon the geologic history of the area.

An *aquiclude* is a body or zone that does not yield or transmit its water readily. Like an aquifer, a number of aquicludes may underlie a site, depending upon the geologic history of the area.

As both aquiclude and aquifer are qualitative terms, broad application of these terms is possible. Frequently encountered are geologic conditions where either terminology may be applied using such expressions as "poor aquifer" or "leaky aquiclude."

In some areas, layers of low permeability lie locally above the water table. Downward percolation of recharge in these areas is temporarily retarded and local bodies of ground water, termed *perched water*, form above these layers. Water contained in these bodies can be stored under either confined or unconfined conditions (see subsequent discussion on ground water storage). Although seepage is usually downward through these layers, springs may occur where they crop out. Storage in perched water bodies appears to respond more markedly to short-term fluctuations in precipitation than storage in the main ground water reservoir. During long periods of deficient precipitation, even the more extensive of perched water bodies may be dissipated completely.

Openings and passages in consolidated rocks have been formed as the result of buckling, stretching, and shearing actions resulting from earth movements. Shrinkage, expansion, and folding of rocks produce similar results. Gases and vapors released during the cooling of molten rock produce porous-structured rocks such as pumice. Ground water seeping along established joints, cracks, and fissures gradually dissolves the more soluble portions of the rock, enlarging seepage channels.

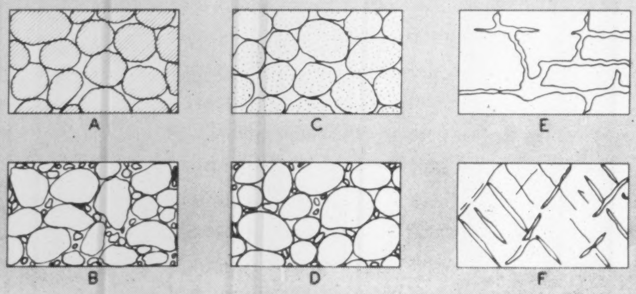
Much of the U.S. in geologic history has been inundated by sea water. For one reason or another, huge areas were isolated from the oceans. Gradual evaporation of these entrapped waters resulted in the precipitation of dissolved salts, such as calcium carbonate, and in the formation of limestone.

Marine Shells Part of Formation

In some regions, marine organisms living in these waters contributed their shells to the calcareous accumulation as they died, giving rise to limestone formations such as the Ocala limestone. These formations, as a result of this accumulation, are largely composed of fossilized shells cemented together.

Formation of unconsolidated ground water reservoirs is somewhat different. Deposition by wind and/or flowing water is largely responsible for their origin.

The carrying power of wind is a function of its speed. In certain areas, such as at Cape Hatteras, winds are sufficiently strong to deposit coarse sand in sizeable dunes. Originally formed by waves and currents, part of this barrier beach has been elevated a hundred feet or more as the result of wind action.



1 RELATION of rock texture to porosity:

A) Uniform sand — high porosity

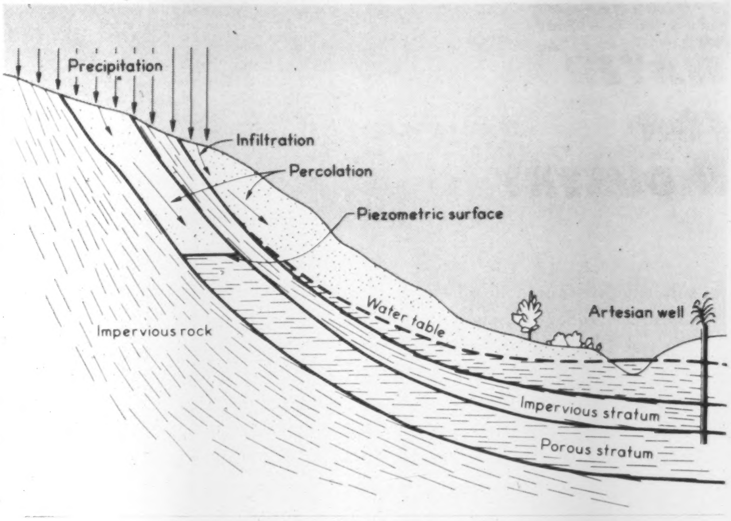
B) Fine to coarse — low porosity

C) Uniform calcareous sand with porous grains — high porosity

D) Sand cemented with calcareous deposit — low porosity

E) Solution openings in consolidated rock

F) Openings in fractured rock



2. GROUND WATER stored under unconfined (water table) and confined (artesian) conditions

Flowing water can transport sediment according to its velocity. The size of particle and the velocity of water to transport it is shown in the following tabulation:

Material	Velocity required to move material along river bottom, fps
Fine clay	0.25
Fine sand	0.5
Pebbles ½ in. in diameter	1.0
Pebbles 1 in. in diameter	2.0

Decreases in stream velocity, such as those resulting from channel widening or entrance into a delta, reduces the sediment-carrying ability of a river and its bed-load is deposited. Depending on the flow characteristics of the stream, the composition of a stream bed is being changed constantly. During times of low river stages, the slower velocity of the water erodes only relatively fine material. Deposition of this material over the coarser sand previously laid down produces a marked stratification within the bed. During times of high stream stages, all layers may be churned up and shifted; even boulders may be rolled along the river bottom.

Some Reservoirs Caused by Glacial Action

In many areas, the origin of the ground water reservoir is closely related to glacial action. At various times in the geologic past, glaciers have extended over most regions of the U.S. north of 40 deg latitude. Foremost in the effects of glaciation as far as ground water is concerned are: compaction of aquifers by thousands of feet of ice; scarifying of consolidated rock and backfilling with more permeable material; deposition of silty and/or clayey material over more permeable rocks; creation of sandy reservoirs (known as drumlins, kames, and eskers.) within material of lower permeability; and the deposition of extremely permeable material near the southern extremity of the melting glacial front. This latter material is termed *glacial outwash.*

In some areas the type of reservoir is well defined. Structurally sound rock (such as granite), extending to great depth yielding only small quantities of water through a small number of joints and fractures, form one extreme. At the other extreme, are reservoirs composed of coarse glacial outwash deposits, or porous limestone, yielding large quantities of water wherever tapped. In between exists a variety of combinations of unconsolidated and consolidated reservoirs. Masses of clay intercalated with permeable limestone, sandstones intruded with impermeable zones of solidified magma, sands interlayered with clays and shales, and layers of porous limestone interspersed with impermeable layers of chert where waterborne silica has replaced the original minerals deposited, are but a few of the many possible variations.

Storage Is Either Confined or Unconfined

Water is stored within the structure of the ground water reservoir under both unconfined and confined conditions. These conditions, also termed *water table* and *artesian* conditions, respectively, are illustrated by Fig. 2.

The essential difference between these conditions lies in the origin of the pressure under which the water is stored. Under water table conditions, at-

GROUND WATER FOR INDUSTRY

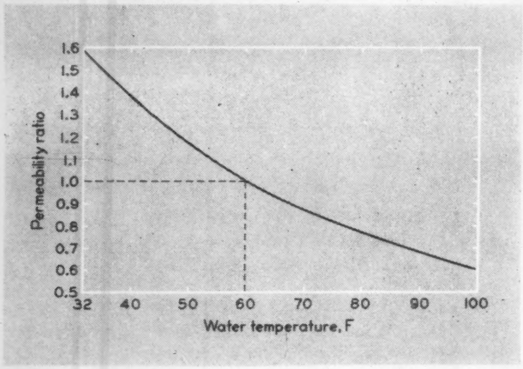
mospheric pressure acts on the surface of the water in storage. Under artesian conditions, water stored beneath a layer of relatively impermeable material (aquiclude), such as clay or shale, is subjected to hydrostatic pressure. This hydrostatic pressure, arising from water stored within the aquifer at higher elevation, causes the water level in a well that terminates in the artesian formation to rise above the bottom of the confining impermeable layer. In many cases, this pressure is sufficient to raise the water to land surface and cause the well to flow. The water levels in artesian wells are termed piezometric levels. When a grouping of these levels are under consideration, they are said to be part of an imaginary pressure surface called a piezometric surface.

A well does not have to flow to be classed as an artesian well. Moreover, artesian conditions occur only when the voids of an aquifer have been completely filled. After that point, further ground water storage takes place by compression and consolidation of the aquifer structure and the water contained therein.

Only part of the water stored in an aquifer can be drained, for a molecular film coats rock surfaces. In an unconfined aquifer composed of unconsolidated material, the volume of water that can be drained by gravity from a unit volume of aquifer is termed *specific yield*. The volume of water that remains in the unit volume of aquifer after such drainage is called *specific retention*. Porosity of the unit volume under consideration is the sum of these two fractions.

Listed below are porosities for some of the rocks that commonly compose the ground water reservoir:

Material	Porosity-Percent
Clay	45 to 55
Silt	40 to 50
Medium to coarse mixed sand	35 to 40
Uniform sand	30 to 40
Fine to medium mixed sand	30 to 35
Gravel	30 to 40
Gravel and sand	20 to 35
Sandstone	10 to 20
Shale	1 to 10
Limestone	1 to 10
Granite, schist and gneiss	less than 3
Quartzite	less than 1



3 VARIATION in ratio of permeability of aquifer containing water at any temperature to permeability of same aquifer with water at 60 F is shown by curve above

More often than not, the material sampled at one point in an aquifer differs markedly from that sampled at another point. Therefore evaluation of an aquifer requires consideration of the aquifer as a whole rather than considering it on the basis of the sampled portion only.

In artesian aquifers, the concept of drainage of voids is not applicable when considering the volume of water stored under artesian pressure. Accordingly, the term *specific yield* is replaced with the term *coefficient of storage*. This represents the volume of water released from storage in each vertical aquifer column having a base one ft square for each ft decline in artesian head. Coefficient of storage, unlike specific yield, depends only on the elastic properties of the rocks that compose the aquifer and those of the water in storage. Porosity of the aquifer enters into the picture only to the extent that it determines the relative volumes of rock and water that are present.

Theoretically, the coefficient of storage of an aquifer can be computed using an estimated porosity together with the elastic properties of the rocks of the ground water reservoir and the stored water. Practically, such an approach has extreme limitations; it is usually not possible to determine to any degree of accuracy the type and extent of the various rocks that compose the ground water reservoir and their elastic properties. Nor is the porosity of these rocks readily ascertained. Field pumping tests, to be discussed in a subsequent article, are a more convenient and accurate way of obtaining the coefficient of storage.

A similar set of definitions can be applied to consolidated rock reservoirs. But owing to the extreme variation in the occurrence of cracks, joints, and fissures in consolidated rocks, these terms have less significance.

Ground Water Moves Constantly

Ground water in storage is constantly moving, although at an extremely slow rate. Unlike flow in pipes, which usually takes place in the region of turbulent flow, ground water movement takes place in the region of laminar flow. One possible exception to this laminar condition is the flow of ground water in the immediate vicinity of a pumped well. This case will be described in a subsequent article.

Ground water flows at a rate proportional to the hydraulic gradient and the permeability of the material through which the ground water moves. In most cases, the hydraulic gradient is the slope of the water table (unconfined aquifer) or of the piezometric surface (confined aquifer). Permeability, qualitatively, is a term that describes the relative ease with which water is transmitted through various rocks under a given set of conditions. Quantitatively, the term is a coefficient that relates the various factors influencing ground water movement and enables the prediction of ground water movement. This relationship, termed Darcy's Law, is as follows:

$$v = PI/7.48\ \phi$$

where:

v = velocity of ground movement, ft per day
P = permeability of aquifer in direction of flow, gal per day per sq ft, under hydraulic gradient of 1 ft decline in head for each foot along gradient, at 60 F
I = hydraulic gradient, ft per ft
ϕ = porosity, dimensionless.

The extremely slow movement of ground water under typical natural conditions, where P is 1000 gal per day per sq ft, I is 10 ft per mile, and the porosity is 1/3, is evident by substitution in the above formula.

Thus:

$$v = [1000 \times (10/5280)]/[7.48 \times 1/3] = 0.8 \text{ feet per day}$$

Aquifier Permeability Varies

Permeabilities for various types of materials range widely. Traces of silt and clay in an aquifer can markedly decrease its permeability. Even for aquifers composed of the same geologic material, grain arrangement and shape and cementation of particles may account for sizeable differences of permeability. Below are permeabilities for some of the materials that compose the ground water reservoir:

Material	Permeability, gal per day per sq ft
Clean gravel	as high as 90,000
Medium to coarse sand	2000
Silt	10
Fine sand and silt	6
Clay	less than 0.0002
Limestone	as high as 100,000

Because of the wide variation in permeability possible, these are presented for purposes of comparison only.

Permeability not only depends upon the characteristics of the aquifer structure but on the ground water stored therein as well. Separation of permeability into its component parts is shown below:

where:

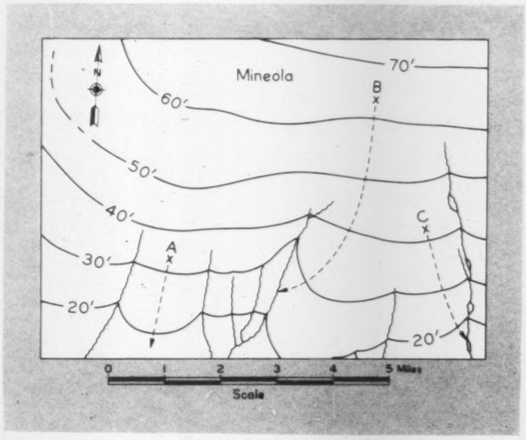
$P = K\ (\gamma/u)$
K = permeability of the aquifer structure only.
γ = specific weight of the stored ground water.
u = viscosity of the stored ground water.

As viscosity is a function of the temperature and density of the ground water, the permeability of an aquifer is variable. Salt water moves more slowly through a given sand than does fresh water; hot water moves more rapidly through the same sand than does cold water. Shown in Fig. 3 is the variation of the ratio of the permeability of an aquifer containing water at any temperature to the permeability of the same aquifer containing water at a temperature of 60 F.

As can be seen, water at 100 F moves through a given aquifer 2½ times more rapidly than water at 32 F. Refinement of permeability into its components is usually unnecessary, because the coefficient of permeability determined by deep well pumping is automatically adjusted to the ground water temperature. Separation of permeability into its component parts may be necessary, however, in problems involving the recharge of spent cooling water or infiltration of warm river water into an aquifer used as a source of cooling water.

Hydraulic Gradient Plays Major Role, Too

Of importance comparable to that of permeability



4 EFFECT OF STREAMS on regional movement of ground water in central Long Island, N.Y. Regional trend for portion of island shown is toward ocean, which borders southern shore in the velocity of ground water flow is the *hydraulic gradient*. In areas where natural conditions prevail, the hydraulic gradient is related to the lithology, dimensions, and shape of the ground water reservoir, the precipitation pattern, and the proximity of the point in question to and its direction from a regional *sink* where the continuous discharge of ground water can take place. In nearshore areas, such a sink is formed by the ocean. In other locales, it can be formed by large rivers. Pumping wells and ponds and marshy areas where evaporation occurs may also act as sinks and affect the direction of the regional ground water movement.

Within an aquifer — away from streams, recharging or pumping wells, and other such influences — the regional flow parallels the regional hydraulic gradient. At points near streams and near pumping and/or recharging wells, water is diverted from the direction of its regional movement.

Fig. 4 illustrates the effect of streams on the regional movement of ground water in central Long Island, New York. For the portion of the island shown, the regional trend is toward the ocean, which borders the southerly shore. The paths of three particles of water lying in the water table are shown. As ground water flow takes place in a direction at right angles to the water table contour lines, a slug of ground water at point (A) would move in a seaward direction between the streams. Ground water at sites (B) and (C), however, would travel in the curved paths shown, being diverted by the streams. Eventually, these particles would also appear in the ocean but as stream flow rather than as ground water discharge.

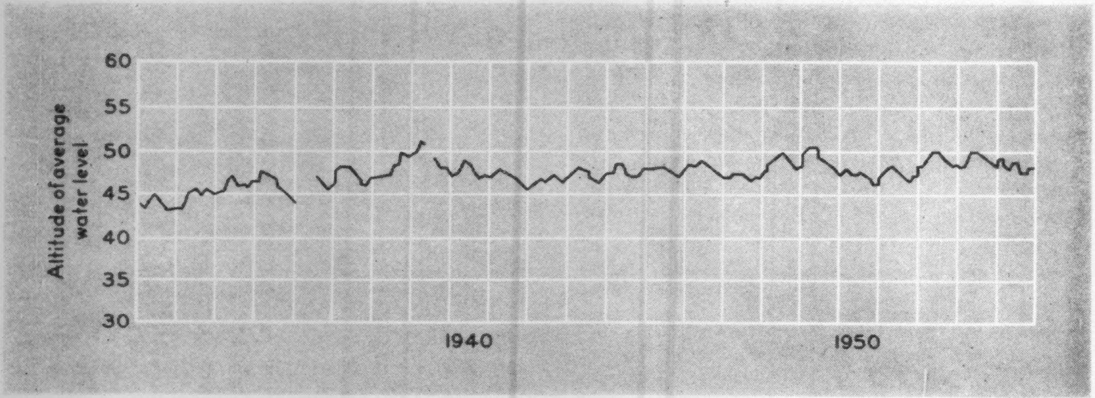
An Endless Cycle: Replenishment-Depletion

Ground water reservoirs are being constantly depleted and constantly replenished through the efforts of nature and man. Considering the ground water reservoir underlying an area as a unit, the following factors influence replenishment and depletion:

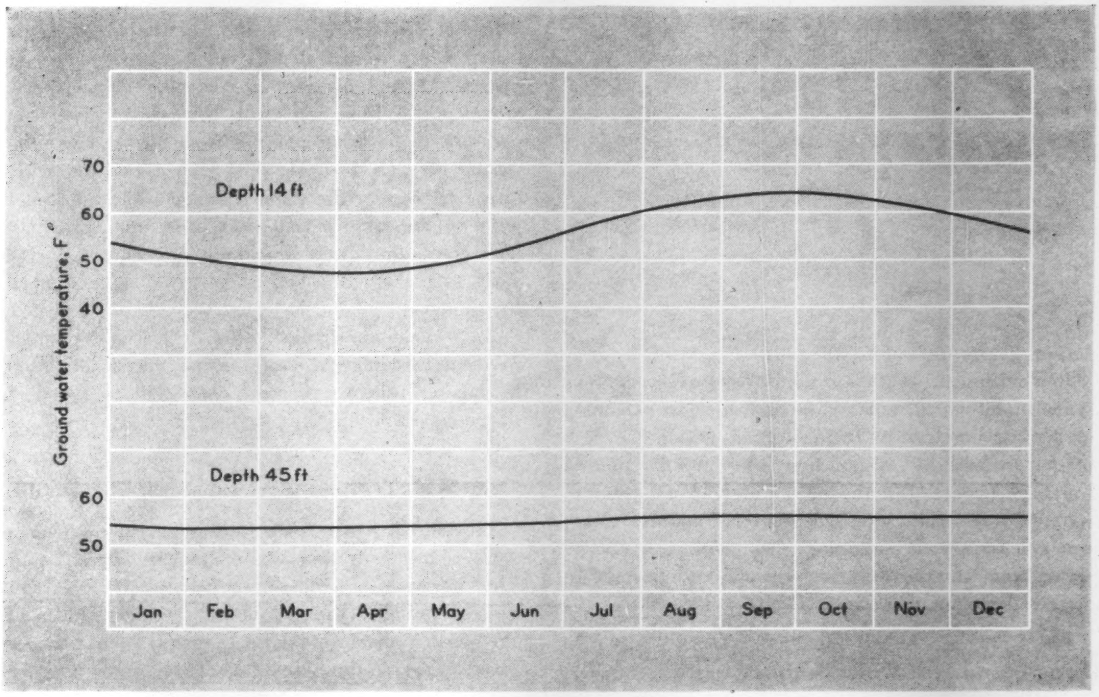
Replenishment	Depletion
1. Infiltration from precipitation.	1. Evaporation.
2. Recharge from wells and other infiltration devices.	2. Discharge through wells, trenches, canals, etc.
3. Ground water flow into the area.	3. Ground water flow out of the area.
4. Recharge from surface bodies of water, such as streams flowing into area.	4. Discharge to surface bodies of water, such as streams flowing out of area.

Precipitation, in the form of rain, snow, hail, or sleet, is usually the predominating factor of recharge. The average annual precipitation in the U.S. ranges from over 100 in. in western Oregon and Washington to less than 5 in. in the western desert areas. East of the Mississippi River the annual average is well above 30 in. in most places, extending to over 50 in. in many areas along the southeast coast.

Between the Mississippi and the lee side of the mountains in eastern Washington, Oregon, and California, the average annual precipitation ranges from less than 5 in. to about 35 in., with the exception of the Gulf Coast. Along the Gulf Coast, which forms the southerly border of this latter area, the average



5 HYDROGRAPH of the average month-end water levels of 14 wells located in central Long Island, N. Y., for years 1932 to 1954 inclusive



6 GROUND WATER TEMPERATURES at shallow depths are influenced markedly by local air temperatures, as shown by monthly variations indicated above, measured at same site but at different depths

annual rate of precipitation is slightly higher.

Evaporation is usually the one factor that has the greatest depleting effect on the ground water reservoir. Evaporation is a composite term which includes removal of water from soil, water, and plant surfaces. Some of the water evaporated is intercepted before it reaches the ground; some of it is withdrawn from the soil and plants by capillary action; the remainder is evaporated from soil and water surfaces. Depending largely on the wind speed, amount of isolation and relative humidity, evaporation throughout the U.S. is an extremely variable factor.

Recharge-Discharge Rates Affect Water Levels

Changes in either the rate of recharge or the rate of discharge, or both, results in changes in ground water storage. Fluctuations of water levels in wells screened immediately beneath the water table for unconfined conditions, or beneath the confining layer in the case of confined conditions, indicate these changes in storage. Fig. 5 is a hydrograph of the average of month-end water levels measured from 1932 to 1954 in 14 observation wells located in central Long Island. As can be seen, the water table does not remain at one elevation. The range of fluctuation of the average water level shown is about 9 ft for the period of record and about 4 ft for any one year. The range of water level fluctuation in most of the individual wells, however, is much larger.

Evident from this hydrograph is the marked effect that evaporation has on ground water storage. For most years on Long Island, and in most other areas for that matter, minimum storage in the ground water reservoir occurs during the late summer and fall. Maximum storage occurs during the spring. Even during summers experiencing above normal precipitation, evaporation of intercepted rainfall usually prevents appreciable recharge to the ground water reservoir.

Precipitation Replenishes Water Reservoir

That portion of the rainfall that seeps into the top soil during these times usually replenishes the moisture deficiency of the root zone. Water in this zone is tapped by plants and returned to the atmosphere by transpiration or is raised through interstitial spaces in the soil to the surface to be evaporated. During late fall, however, water consumption by plants markedly diminishes, as do the other factors affecting evaporation. As a consequence, precipitation can replenish the ground water reservoir more effectively. Normal precipitation during these

GROUND WATER FOR INDUSTRY

periods causes the water table to rise.

Replenishment of the ground water reservoir in some undeveloped areas dissected by few streams may occur simply from incident precipitation and depletion simply by evaporation and lateral ground water movement. But the effects of man on ground water storage may supersede those of nature. Continuous large-scale pumping may withdraw more water from storage than is returned, resulting in a serious depletion of storage.

Long Island Lost Water Supply

No better example of this is found than the contamination of the ground water supply in the western part of Long Island. Here, during the first half of this century, the ground water reservoir was pumped down faster than precipitation could replenish it. Recharge to these aquifers was reduced because storm runoff from this intensely developed area was discharged seaward through sewers. The water table was depressed to levels far below sea level, and sea water seeped into the fresh water-bearing beds. Discontinuance of a large part of these withdrawals toward the mid-point of the century permitted storage to increase and the water table to rise. But the damage was done; and the water supply for this area today must be obtained from upper New York State.

Water Temperature Averages With Air

The temperature of the ground water stored immediately below the water table and to a depth of about 200 ft is generally within 6 F of the average annual air temperature. Precise ground water temperature measurements made in eastern Long Island indicate that the effect of air temperature on ground water temperature in that area is greatly reduced at a depth of about 300 ft. Below this, the ground water temperature is predominantly influenced by the earth's temperature.

At shallow depths, ground water temperatures respond to a greater degree with the local air temperature. For example, the monthly variation in the ground water temperature measured in two wellpoints at the same site in the central part of Long Island, but screened at different depths, is shown in Fig. 6. These wells were driven into glacial sands to a depth of 14 ft and 45 ft, respectively. The temperature of the water sampled from the shallow point ranged between 46.7 and 62.5 F, while the temperature extremes for the water sampled from the deeper point in the same period were 53.2 and 54.8 F. In both cases, the lowest temperatures occurred during early spring and the highest occurred at the end of the summer.

As is evident, shallow wells drilled and pumped in the late winter or early spring may yield water having a lower temperature than that at the peak of the air conditioning season.

Deep-Well Temperatures Increase With Depth

In general, water temperatures measured in deep wells show a proportionate increase with depth. This increase in temperature per 100 ft of vertical descent is called the *geothermal gradient.* Although the earth's thermal gradient varies from place to place, a rough approximation of the water temperature at a given depth can be made by adding to the average annual air temperature of the area, 1 F for every 64 ft of depth. However, slight differences in the geothermal gradient may result from variations in the local geology; therefore such a procedure must be used with caution.

Well completion does not insure a successful installation. Important to the success of a well installation is the geologic and hydrologic conditions at site, the temperature and chemistry of the ground water, and the factors influencing the movement of ground water through an aquifer, especially in the vicinity of a pumped well. These latter factors have been discussed briefly in the present article. In another article, to appear in an early issue, the hydraulics of ground water and wells, and aquifer performance tests and their relationship to successful well installation will be further elaborated. ‡

". . . the effects of man on ground water storage may supersede those of nature"

How To Correct Standard Condition Ratings For Centrifugal Fans and Pumps

By F. CAPLAN
Kaiser Engineers
Div., Henry J. Kaiser Co.

CENTRIFUGAL FAN and pump manufacturers list the performance characteristics of their products for assumed standard conditions; usually 70 F and 29.92 in. of Hg atmospheric pressure. Since the performance of a centrifugal fan varies with the density of the fluid delivered and with speed, rating corrections must be made for variations from the manufacturer's assumed standard conditions.

The accompanying nomograph does this graphically for the following relationships:

a) For a given fan at constant speed

$$(bhp)_2 = (bhp)_1 \times \rho_2/\rho_1 \qquad (1)$$

$$P_2 = P_1 \times \rho_2/\rho_1 \qquad (2)$$

where

(bhp) = brake hp required
ρ = density of fluid
P = pressure developed by fan; static, velocity, or total

b) For a given fan with fluid density constant

$$(cfm)_2 = (cfm)_1 \times (rpm)_2/(rpm)_1 \qquad (3)$$

$$P_2 = P_1 \times (rpm)_2^2/(rpm)_1^2 \qquad (4)$$

$$(bhp)_2 = (bhp)_1 \times (rpm)_1^3/(rpm)_2^3 \qquad (5)$$

where

(cfm) = cfm of air delivered
(rpm) = fan speed

c) For a given pump at constant speed and fluid density

$$(gpm)_2 = (gpm)_1 \times D_2/D_1 \qquad (6)$$

$$H_2 = H_1 \times D_2^2/D_1^2 \qquad (7)$$

$$(bhp)_2 = (bhp)_1 \times D_2^3/D_1^3 \qquad (8)$$

where

(gpm) = pump capacity in gal per min
D = pump impeller diameter
H = head developed by pump

d) For a given pump with fluid density and impeller diameter constant

$$(gpm)_2 = (gpm)_1 \times (rpm)_2/(rpm)_1 \qquad (9)$$

$$H_2 = H_1 \times (rpm)_2^2/(rpm)_1^2 \qquad (10)$$

$$(bhp)_2 = (bhp)_1 \times (rpm)_2^3/(rpm)_1^3 \qquad (11)$$

For values which fall beyond the ranges shown — if any scale value on the left half of the chart is multiplied by "*N*" then its corresponding scale value on the right half of the chart must also be multiplied by "*N*."

Example 1:

A fan which is rated at 7250 cfm, 7.22 bhp, and 3 in. SP for 0.075 lb per cu ft of air, is to be used for 0.0414 lb per cu ft of air. For the same cfm and fan speed, what brake hp is required and what pressure will be developed?

Solution: Align ρ_1 = 0.075 = (0.001) 75, in Col. *D1*, with ρ_2 = (0.001) 41.4 in Col. *D2*, and mark the intersection at pivot line α. Align α with P_1 = 3 = (0.1) 30, Col. *D1* and read, in Col. *D2*, P_2 = (0.1) 16.6 = 1.66 in. pressure. Align α with $(bhp)_1$ = 7.22 = (0.1) 72.2 in Col. *D1*, and read, in Col. *D2*, $(bhp)_2$ = (0.1) 40 = 4.0 brake hp.

Example 2:

A certain fan has a 2-speed motor. It delivers 12,000 cfm at a static pressure of 1 in WG when operating at a speed of 400 rpm, and requires an input of 4 hp. When operating at 500 rpm, what cfm, static pressure, and power are developed and required?

Solution: Align $(rpm)_1$ = 400 = (0.01) 40,000, in. Col. *M1*, with $(rpm)_2$ = 500 = (0.01) 50,000 in Col. *M2*, and mark the intersection at pivot line α. Align α with $(cfm)_1$ = 12,000 in Col. *M1* and read $(cfm)_2$ = 15,000 in Col. *M2*. Align α with P_1 = 1 in. WG in Col. *P1* and read P_2 = 1.56 in. WG in Col. *P2*. Align $(bhp)_1$ = 4, in Col. *B1* and read $(bhp)_2$ = 7.8 in Col. *B2*.

Example 3:

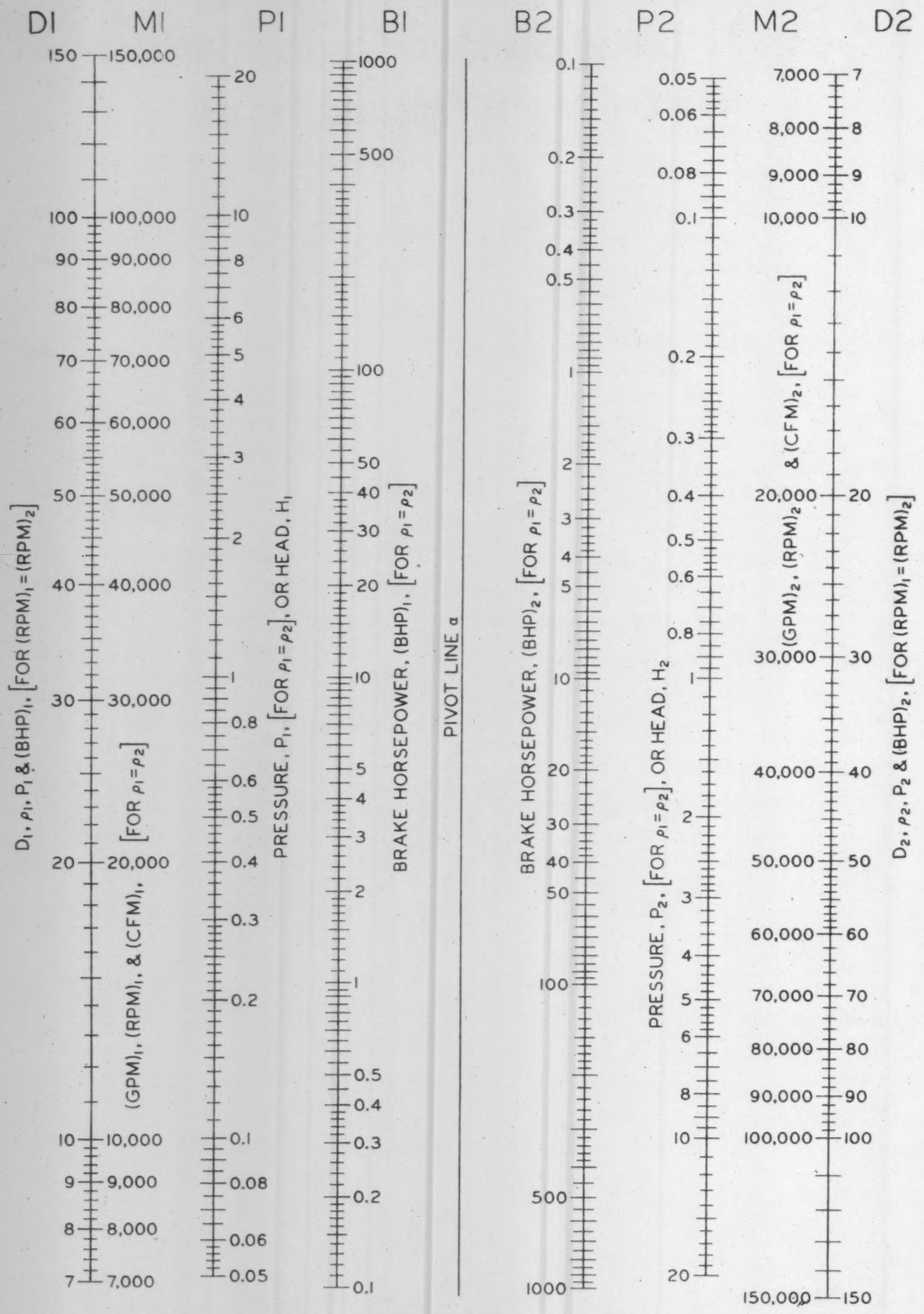
It is desired to increase a pump's capacity by increasing the impeller diameter from 10 to 11 in. If originally the pump capacity was 12,000 gpm at 9 ft head using 5 hp, what will be the capacity, head, and required power using the larger impeller?

Solution: Align D_1 = 10 in Col. *D1* with D_2 = 11, Col. *D2* and mark the intersection with α. Align α with $(gpm)_1$ = 12,000 in Col. *M1*, and read $(gpm)_2$ = 13,200 in Col. *M2*. Align α with H_1 = 9, Col. *P1*, and read H_2 = 11, Col. *P2*. Align $(bhp)_1$ = 5, Col. *B1*, with α and read $(bhp)_2$ = 6.7 in Col. *B2*.

Example 4:

It is desired to increase a pump's capacity by increasing its speed from 1600 to 1800 rpm. If the original capacity was 2310 gpm at 166 ft with 114 bhp, what will be the capacity, head, and required power at the new speed?

Solution: Align $(rpm)_1$ = 1600 = (0.1) 16,000 in Col. *M1* with $(rpm)_2$ = 1800 = (0.1) 18,000 in Col. *M2*, and mark pivot α. Align α with H_1 = 166 = (100) 1.66, Col. *P1*, and read H_2 = (100) 2.10 = 210, in Col. *P2*. Align α with $(gpm)_1$ = 2310 = (0.1) 23,100 in Col. *M1*, and read $(gpm)_2$ = (0.1) 26,000 = 2600, Col. *M2*. Align $(bhp)_1$ = 114 in Col. *B1*, with α, and read $(bhp)_2$ = 163 in Col. *B2*. ⧺



THIS NOMOGRAPH can be used to correct centrifugal fan and pump characteristic data, furnished by manufacturers for standard conditions of temperature and density, to compensate for design variations from standard conditions

the law and your profits

JOHN F. MORRISSEY, author of this regular feature, is an attorney at law and has an extensive practical business and legal background. This series is based on actual cases. All names are, however, fictitious. It should, of course, be remembered that the law varies in different states.

Contractor May Be Liable for Fitness of Equipment Without Express Warranty

IT IS common practice today for manufacturers and contractors to give express warranties as to the fitness of devices sold and good workmanship. Under the Common Law interpreted by our earlier courts, the doctrine of caveat emptor (let the buyer beware) was more rigidly applied, and no warranty of fitness that was not expressed was ever implied.

This strict doctrine has been greatly modified by both statutory law and our courts in modern times. Still, where defects in things sold are apparent or readily revealed upon ordinary examination, the seller will not generally be held responsible.

But since people do not ordinarily purchase machines or devices with obvious defects, questions of what express warranties mean, or what warranties will be implied by law, are often a subject of litigation, as demonstrated by the following case.

The U. Trious Drug Store contracted for the purchase and installation of a large air conditioning unit with Stub, Orn & Co. Twenty six days after the installation the unit ceased functioning.

The company sent a repairman to the store but when he failed to remedy the trouble U. Trious purchased another unit from another company and advised Stub, Orn & Co. to kindly take back their unit and refund the purchase price. This Stub, Orn & Co. refused to do and they were soon made a defendant in a lawsuit.

In court the drug store presented the testimony of an air conditioning maintenance man that he had inspected the unit on the day after its installation and, although it appeared to be operating satisfactorily, his tests disclosed electrical defects which he was unable to locate.

There was some question as to what, if any, warranties the defendant company had given but U. Trious argued that he had received a verbal guarantee of complete satisfaction with the unit.

The defendant denied any such guarantee and contended that the satisfactory operation of the unit for a period of 26 days evidenced the fact that it was in good condition at the time of installation.

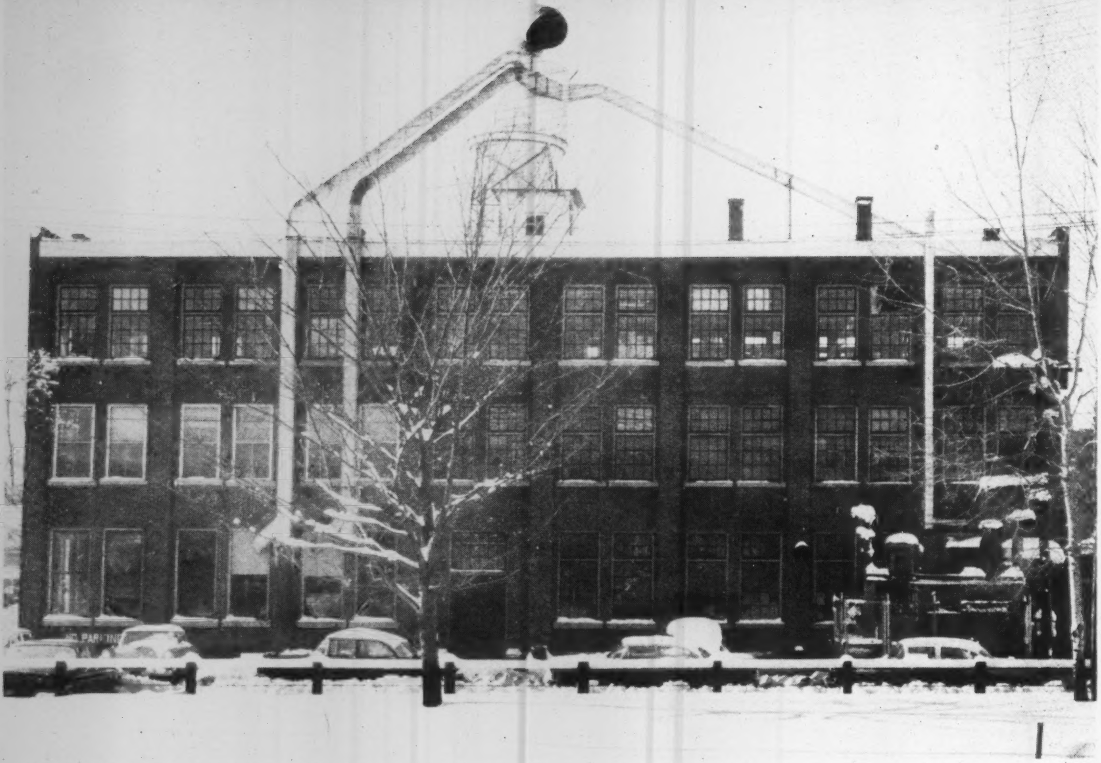
"We reject," said the court, "the harsh common law doctrine of caveat emptor and subject a seller to the responsibility of warranting the fitness of what he sells. But a defect must be one which renders the thing absolutely useless, or its use so inconvenient and imperfect, that it must be supposed that the buyer would not have purchased it, had he known of the defect.

"Whether any express warranties were made in this case is immaterial in view of the legally implied condition of every sale that the thing sold is free of hidden defects.

"Operation of the unit for 26 days was not sufficient to relieve the defendant of its obligations under the implied warranty, first, because there is evidence that a hidden or latent defect existed at the time of installation, and, second, because it cannot reasonably be considered that the buyer would have purchased the unit if he had known that its use was to be limited to the brief period of 26 days."

It is only speculative as to how the court would have viewed the case if the unit had continued to operate for two months or six months rather than only 26 days. The courts usually rely upon the uncertain criterion of "reasonable" when related to a certain transaction or set of facts.

Stub, Orn & Co. lost because, though they may not have made a warranty, the law made one for them. ✢



LARGE EXHAUST SYSTEM at Springville, N.Y. plant of Robinson Knife Mfg. Co., removes 30,000 cfm of air and residue from plant's grinding and polishing department. Makeup air is supplied by system using duct heaters

Industrial Exhaust Systems Need Makeup Air Supply

● Choked by the huge volumes of air removed by powerful plant exhaust systems, industry today is in greater need of proper makeup air supply than ever before. In wintertime, particularly, is this problem acute, since negative pressures inside pull in cold outside air to cause discomfort to workers. The dangers of drawing contaminated air into occupied spaces also looms as a hazard. The answer to these and other plant ventilation problems is found in the makeup air system. This article tells how to design such a system, including its application, type (depending on requirements), equipment selection, control, and maintenance and operating cost.

By GEORGE REZNOR
Vice President—Engineering
Reznor Mfg. Co.

Makeup air systems are of prime importance in any building with large exhaust requirements and no positive method of replacing the exhausted air. Such buildings may include mills, machine shops, chemical process plants, and even bakeries, dry cleaning shops, and restaurants.

In general, if building air is exhausted to remove fumes, smoke, odors, or contaminated or otherwise unwanted air, the air must be replaced. Lack of a makeup air system creates a problem of negative pressure in the building. The exhausted air is replaced by outdoor air infiltrating through openings in a building such as windows, doors, or cracks. Dirt enters into the building from outside, doors are difficult to open, air flow in flues may reverse, and health hazards could occur.

Physical discomfort particularly occurs in wintertime, when outdoor air is drawn into the building by negative pressures inside. In addition, if the building's heating system has not been sized to cope with this problem, the heating system is overtaxed.

The problems encountered usually are the same whether we are considering a new or an existing building. The makeup air system itself varies in design only with the building operation, the severity of seasonal changes in temperature, and geographical location. For practical purposes, this article deals with systems operating summer and winter, and located in areas where design temperatures are below 35 F.

No Two Installations Alike

Every building, or operation within a building, presents peculiar and individual problems which must be analyzed so that the need for makeup air is justified in comfort and safety for the individuals in it. The makeup air system also must be economically sound for the building operation.

Consider the problem of individual spaces within a building that require positive air exhaust. Exhaust in these spaces often is required because a particular process creates undesirable heat or air contaminated by fumes, odors, or particulate matter. This situation requires the most critical analysis for proper solution, since an exhaust system may draw contaminated air from another space, possibly upsetting the production process, or even threatening employee health.

One example of this is woodworking facility located adjacent to finishing areas. An exhaust system usually is provided to remove dust created in the woodworking shop. The finishing areas also require exhausts for the paint sprays. If positive and clean makeup air is not provided to the paint area, contaminated air could be drawn from the adjacent spaces, also upsetting the exhaust system in the woodworking area.

Warehouse Offices a Problem

Another example is met where heated or air conditioned offices are located within a large storage area such as a warehouse. If the warehouse area is exhausted, its fans will pull conditioned air from the office spaces, upsetting the heating or air conditioning system and creating other problems with the air distribution system.

Areas with furnaces also are usually supplied with large air exhaust systems, often resulting in as many as 20 air changes per hour. This, of course, creates a serious problem if no makeup air is supplied. The fans will draw replacement air from adjacent spaces, creating a problem when doors must be opened or closed. If the negative pressure is great enough, it may reverse the flow of gases in flues or chimneys.

Before any makeup air system is designed, careful analysis must be made not only of the amount of makeup air required, but also of the type of system to be installed, the expected operation pattern of the system, and how the system can best be adapted to the building's construction.

Sizing the Installation

Sizing and selection of the equipment can vary with requirements, but generally, sizing is accomplished as follows:

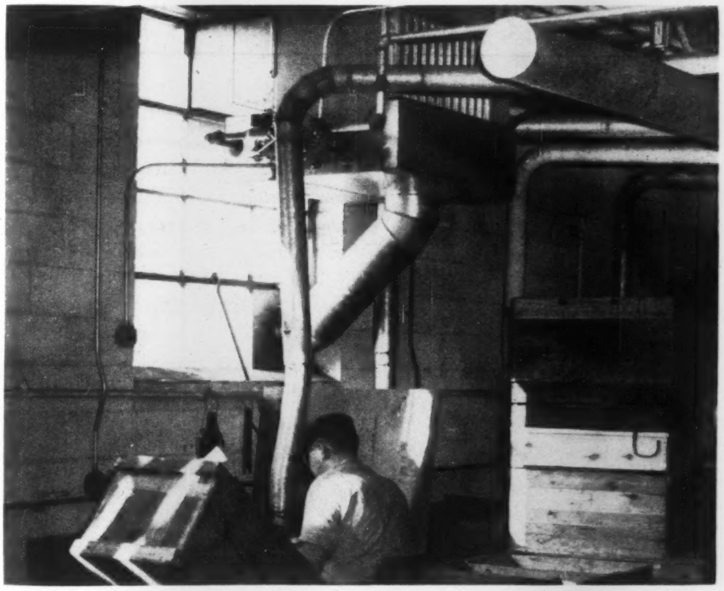
1) The amount of exhaust air must be calculated.

2) Determine the amount of makeup air needed. This should always be slightly higher than the amount exhausted in order to maintain positive air pressure in the space. A figure of 110 percent of exhausted air is generally considered.

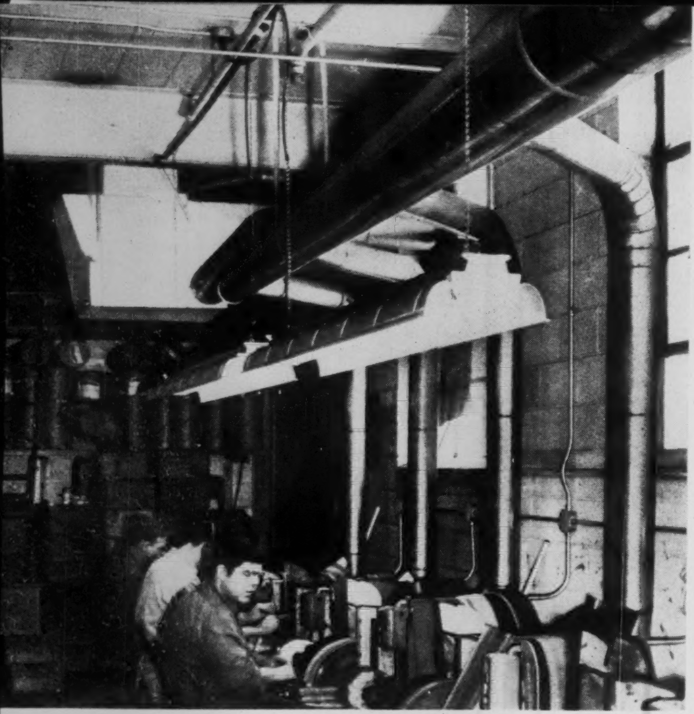
3) Calculate the amount of tempering. The unit should be sized so that it is capable of producing a discharge air temperature a few degrees above room temperature. A maximum discharge temperature capability of from 75 to 80 F suffices in general, although the actual discharge temperature will be governed by the requirements of the individual installation.

4) Compute the amount of heat required. This is the product of the amount of exhausted air (in cfm) and the temperature difference between entering air and discharge air, times the factor of 1.085.

Let us take, as an example, a room in which a small furnace is installed, and exhausting the heated air creates a negative air pressure. Suppose the room is being exhausted at the rate of 10,000 cfm. Average room temperature is



MAKEUP AIR is supplied directly from front of heater above polishing machine in cutlery plant. Inlet air enters heater through duct at top, combustion air through separate duct at bottom



GRINDING AND POLISHING residue is vented from each machine to outside; air thus removed is replaced through duct heater mounted near ceiling at rear, above

75 F and minimum outdoor air temperature is zero F.

Fan capacity of makeup air unit = 10,000 cfm × 1.10 = 11,000 cfm
Maximum makeup air temperature, $T_1 = 80$ F
Outdoor air temperature, $T_2 = 0$ F
Quantity of makeup air, $Q = 11{,}000$ cfm
Constant, $K = 1.085$
H, heat load for makeup air in Btu per hr $= Q \times K \times (T_1 - T_2)$
$H = 11{,}000 \times 1.085 \times (80 - 0)$ = 955,000 Btu per hr.

Heat Exchanger Tempers Air

The basic item of any makeup air system is an air handling unit with a heat exchanger to temper the air. The equipment from this point is refined to meet the particular requirements of the operation. The air handling unit circulates the air, while the heat exchanger tempers the air. If clean air is a requirement, filters can be added to the system.

Consideration then must be given to air distribution. Ductwork must be installed if the air handling unit is remotely located. Grilles or diffusers can be added to the ductwork to insure good air distribution. This is the point at which building construction must be considered. Space must be available for the equipment and ductwork.

The heat exchanger can be controlled to temper the air as required by indoor and outdoor conditions.

A careful analysis should be made concerning the type of heat exchanger to be used. Consider the initial installation cost, including equipment, piping, ductwork, and the fuel available, as well as maintenance and operating costs. All of these items will vary with the type of building and location. The heat exchanger could be a direct fired device, or steam or hot water coils. The choice of the type of heat exchanger will vary with the requirements of the system and the type of building construction encountered.

Types of Operation Vary

Another important factor to consider is the operating cost of the makeup air system. This cost depends entirely on the system control and its operation.

Makeup air systems, as such, need operate only while exhaust fans are functioning. But in new buildings, the system can be designed for general heating as well as makeup air. This can be accomplished by control of the outdoor air introduced into the system through automatic dampers, which may be set to vary the amount of outdoor air taken in by the unit. If heating only is required, dampers will permit entrance of a minimum of outdoor air; when makeup air is needed, the dampers will permit entrance of maximum outdoor air. The outdoor air damper can be completely closed during unoccupied periods.

Can Match Exhaust Operation

If a system is installed only for supplying makeup air, it can be controlled to operate only when the exhaust system functions. Makeup air systems should also operate during summer as well as winter periods, providing filtered air all year. This is a benefit that buildings with exhaust systems only do not enjoy.

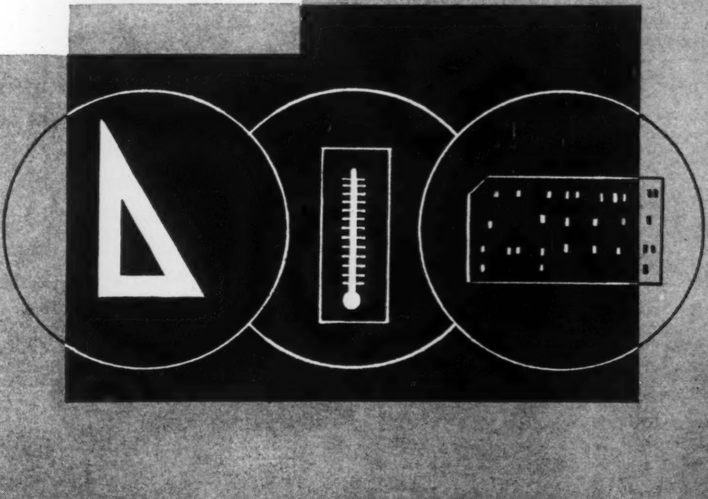
Operating cost of the makeup air system in the summer consists only of the power consumed in driving the fans. In the winter, the cost of fuel for tempering the air is added. In order to analyze this properly, consider the case of a building equipped only with an exhaust system. Infiltration of outdoor air adds to the cost of fuel consumption during cold months, since the existing heating system must overcome this heat loss to maintain temperatures in the spaces at a comfortable and healthful level.

By careful planning, with a makeup air system the amount of additional fuel consumed in winter can be controlled precisely to the point that it occurs only when desired or necessary. The benefits derived from the installation are well worth the investment. ╪

HPAC ENGINEERING DATA FILE

Preventive Maintenance Paves Way to Dependable Operation

- *Know the system*
- *Know the equipment's needs*
- *Estimate manhour requirements*
- *What skills are needed*
- *Adequate but simple records*
- *Train personnel*



Preventive Maintenance: Why and How to Apply It

THE OPERATION of heating, piping, and air conditioning equipment is in many instances automatic and, for this reason, the need for maintaining it is often overlooked until a breakdown occurs. Resulting complaints, loss of production, and equipment failures are often attributed to design weaknesses when in reality neglect of the equipment is at fault. Increased emphasis on air conditioning and the increased magnitude of mechanical equipment in new industrial and commercial construction places greater emphasis on good operation and maintenance procedures if the maximum benefits are to be obtained from these systems.

Two basic approaches are taken toward maintenance, generally. These are *breakdown* maintenance and *preventive* maintenance. In the former, the system is permitted to deteriorate until failure occurs and then all necessary repairs are made to put the system back into good working order. This type of maintenance can probably be accomplished with the least expenditure of maintenance manpower early in a system's life but the risks are great and total costs can be high. The fruits of neglect are reaped as the system ages. During the slow deterioration of an uncared for system, operating costs increase — perhaps in small and unnoticeable increments — due to reduction of heat transfer efficiency, increased friction, greater stack losses, etc. More importantly, the equipment becomes susceptible to accidents[1] which can involve costly parts replacements.

A loose belt, for example, may fail and if it alone failed, replacement would not result in any appreciable expense. However, when it fails, it may involve the pulleys, cause a bent shaft, and thus contribute to breakdown of the rotating components. For lack of simple maintenance of belt tension a whole machine can be lost.

Other losses accompany the gradual deterioration and failure of a system, too. It is evident, and an established fact, that breakdown maintenance is expensive when the manufacturing process, and thus, production depends upon the system functioning properly and continuously. Not so evident, is the loss of personnel efficiency when design conditions are no longer maintained due to equipment neglect. To be sure personnel productivity and its relationship to the environment are difficult to measure, but evidence[2] such as that collected by the General Services Administration indicates that loss of personnel efficiency will result also. This too should be considered a part of the costs of the breakdown maintenance philosophy.

Preventive maintenance has been defined in a number of ways, and it means many things to many people. In general, a preventive maintenance program is one in which the wear and changes a system will undergo during operation are anticipated and continuous corrective action is taken to minimize deterioration. This requires periodic inspection and the replacement of components as ordinary wear takes place to prevent equipment accidents and failures. Fundamentally in its various forms, preventive maintenance involves a planned and controlled program of inspections, adjustment, repair, and analysis of performance designed to keep a system operating at peak efficiency. It has been applied in varying forms and intensity for some time in many industries. Drawing upon this experience and that of engineers responsible for operation and maintenance of heating, piping, and air conditioning systems, the administration and implementation of a preventive maintenance program is presented herein.

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[1] *Numerals refer to references on page 160.*

The need for maintaining heating, piping, and air conditioning systems increases with their age, complexity, and value. These systems lend themselves to the systematic approach of preventive maintenance. A way to establish a program of controlled preventive maintenance is outlined in this report.

While we consider here the case in which a "captive" work force is used to maintain these systems, evidence shows that many building and plant managements successfully contract this work out. However, the basic program of controlled maintenance is still desirable and the basic steps in establishing the program should be the same. The principal difference is, of course, in the labor force.

What To Expect from Preventive Maintenance

The benefits gained from *controlled* preventive maintenance in industry are well known. Some are repeated here as a reminder. These are:

- Greater system reliability
- Less large scale repairs or at least such repairs are required at less frequent intervals
- Useful equipment life is extended
- Minimum standby equipment is required
- Causes of breakdowns and areas of weakness are identified
- Better control of spare parts and lessened inventory
- Operating efficiency is maintained
- Data is obtained to determine when equipment replacement is economic
- Maintenance work load is levelled out

How Much Will it Save?

Many of these benefits can be related directly to reduced operation and maintenance costs. While evidence of savings that can be achieved by practicing preventive maintenance of heating, piping, and air conditioning systems are limited, industry has found[3] that maintenance costs for mechanical equipment can be reduced by as much as 25 percent. This assumes a well managed and controlled preventive maintenance program.

Causes of Recent Accidents to Central Air Conditioning

Preventive maintenance works in industry. Does it apply to heating and air conditioning systems? The causes of recent accidents[1] to central air conditioning systems as determined by insurance inspections and listed here indicate what can be accomplished to prevent failures

	Cause of recent accidents to central air conditioning						
Component	Freezing	Corrosion	Erosion	Vibration	Defective material	Workmanship	Other
Chillers	33	3	2	—	3	—	1
Condensers	5	9	1	1	2	—	2
Control piping	—	—	1	18	4	8	1
Refrigerant piping	2	1	6	37	4	8	1
Chilled water piping	—	—	—	2	1	—	—
Heating coils	11	1	—	—	—	—	—
Chilling coils	3	—	—	—	—	—	—
Evaporative condensers	—	—	—	1	1	—	—
Expansion valves	—	—	1	—	4	—	—
Direct expansion evaporators	—	—	—	1	2	—	—
Totals	54	14	11	60	21	16	5

[1] Reproduced with permission from *The Locomotive* of the Hartford Steam Boiler Inspection and Insurance Co.

Initially, the preventive maintenance approach may result in higher costs due to the additional clerical work load, supplies, etc. However, long term gains can be anticipated. For example, in one plant[4] requiring air conditioning for both comfort and manufacturing purposes, four mechanics were assigned to maintain an 870 ton air conditioning system under a breakdown maintenance system. Coincident with enlarging the system to a capacity of 1885 tons with some 172 major components such as compressors, chillers, pumps, etc., a preventive maintenance system was also initiated as manufacturing and test areas to which cooling was added had critical temperature and humidity control requirements. Inspections and test of the air conditioning system are carried out monthly by a preventive maintenance inspector working some 86 hours. He generates a normal workload for four mechanics though they have time for periodic repair of other heating, ventilation, and refrigeration equipment. Thus, in this case, a doubling of the maintenance burden in terms of capacity caused only a slight increase in maintenance manhour requirements due to the change to a preventive maintenance system.

What is a Good Preventive Maintenance Program?

Every preventive maintenance program must be tailored to the needs of a particular plant or system. It would be a rare case indeed when a successful maintenance program employed in one facility could be adopted without modification and with equal success in another. Yet all programs have fundamental similarities and differ mainly in the way they are applied. Once initiated, application of the "engineering approach" to improving the program results in the evolution of a program specifically fitting the needs of the installation. This requires thorough knowledge of the system and an awareness of good maintenance management procedures.

Successful preventive maintenance programs are comprised of the following:

- Good management maintenance policies
- An inventory of the plant
- Planned and scheduled work
- Standardized operation and maintenance procedures
- Trained personnel
- Adequately tooled personnel
- An adequate system of records
- Program for review of records, schedules, and reporting of accomplishments

Good Management Policies

A cooperative and sympathetic management is necessary for the preventive maintenance program to be successful. To obtain management support, it is necessary[3] to consider their position and determine their point of view in regard to the problem. Reports submitted to them should relate information in terms of their interest. Such reports must be concise and contain definite methods of measuring achievement, proposals for improvements, and justification for steps to be taken.

What to Include in Reports

Some specific suggestions[3] for making a presentation to management given by O. W. Graveley based upon his experience with a maintenance management program are as follows:

"Show the relationship of maintenance to cost of production, generally as a percentage of total cost.

"Provide a measure of maintenance productivity in terms of work sampling, or maintenance cost relative to replacement value of equipment, or by other measuring methods available.

"Analyze operating time for losses due to lack of maintenance and show where improvement can be expected.

"Show that customer relations can be improved or maintained through the good-will generated by keeping promises due to dependable equipment operation.

"Above all, show management that you know your problems and have a plan and time table of improvement for areas requiring attention."

These can be applied directly to existing industrial heating, piping, and air conditioning systems where a product is involved. When the systems exist for comfort and convenience, some modification in approach will obviously be necessary. In the latter instance, the costs of recent repairs made after breakdown with realistic estimates of what the cost of repairs before breakdown would have been will tell part of the story. Estimates of the cost of inconvenience during breakdown, hazards introduced, and the loss of personnel efficiency should also be considered. The dollar savings possible will be evident.

Know the System

The first step in planning a preventive maintenance program is to make a plant inventory. This should include finding and recording answers[5] to some of all of the following questions:

- What equipment does the plant have?
- What are the equipment's characteristics, i.e. type of bearings, nameplate data, etc.?
- What maintenance work is required now?
- What maintenance can be deferred?
- What historical records exist?
- Where is the equipment located?

Existing records are helpful as they will show pertinent physical data, age, and equipment which will present major problems. These bits of information are useful in establishing the program and evaluating the requirements.

In new systems, the mechanical contractor is generally called upon to provide information of this nature. However, more recently, emphasis[6] has been placed on the need for making this a design responsibility. One consulting engineer[7] who provides such services does so with the costs defrayed under allowances provided in the specifications for preparation of an operation and maintenance manual.

The manual prepared by the consulting engineer referred to above contains a description of each system, instructions for operations such as switching and control, maintenance instructions giving detailed observations on work required on each type of equipment, and a maintenance schedule by days, weeks, and months, referring to the maintenance instructions and providing a means of check-off, if desired. When prepared like this, the operation and maintenance manual will provide much of the data required to implement a preventive maintenance program.

When a manual is not available from the consulting engineer or mechanical contractor, one should be prepared as the maintenance management program develops. Most of the data needed is prepared during planning of the program.

At the same time the inventory is made, it is worthwhile to check on plant housekeeping and, if necessary, to bring it up to a high standard. This is an important part of a preventive maintenance program as maintenance is difficult in a dirty and disorderly plant. Steps taken to achieve and maintain good housekeeping are essential to the success of a maintenance program.

Know the Equipment Needs

The listing of equipment to be maintained must be followed by an evaluation of the maintenance requirements of the system and its principal components. This analysis[8] should consider these questions:

- Why must the equipment be inspected?
- What points must be inspected?
- How often should inspections be made?
- What trades or skills are required for the inspection?
- How much time is required for each inspection?
- What lubrication is required?
- How often are adjustments required?
- How often must the equipment be overhauled?

The sources of information of this nature are many and varied. The craftsmen responsible for maintaining the equipment are excellent sources of points that should be inspected. Manufac-

Estimate, Record Times to Perform Various Tasks

Here is a page of work determination schedules from the operation and maintenance manual[12] of a building engineer. Similar entries are included for all pieces of equipment. Estimates are based upon prior experience of the engineer for maintaining the mechanical and electrical equipment in large office buildings. Estimated time standards such as these are necessary to establish maintenance force size and character, and to schedule inspections

Item	Quantity	Services required	How often	Estimated time, hrs	Yearly time, hrs
278 ton refrigeration compressor	1	Clean condenser tubes.	Annually	72	72
		Clean and renew oil in compressor, oil reservoir.	Annually	16	16
		Clean, inspect, and renew oil in turbine.	Annually	8	8
		Inspect and test safety controls.	Annually	4	4
Purge compressors (Accessories to the above refrigeration compressor)	2	Clean, inspect, and renew oil.	Annually	16	16
Condenser pumps	2	Renew bearing grease and replace gland packing.	Annually	4	4
Primary zone chilled water pumps	3	Renew bearing grease and replace gland packing.	Annually	6	6
Interior zone chilled water pumps	4	Renew bearing grease and replace gland packing.	Annually	8	8
Cooling tower (48′ x 18′ x 24′)	1	Drain and clean tower base (cooling season).	Monthly	4	24
		Inspect and replenish lubricant in 2-speed reduction gear boxes.	Annually	4	4
		Check tower fill strips and spray heads.	Annually	4	4
Primary system spray tank	1	Drain and clean.	Monthly	2	24
Primary zone filters and strainers	3	Clean filters and strainers.	Annually	6	6
Interior zone strainers	4	Clean strainers.	Annually	4	4

[12] From *Building and Plant Mechanical and Electrical Equipment and Responsibilities,* Nationwide Mutual Insurance Co., 1958.

turer's manuals provide much information on what and when to inspect. In addition, they provide information on lubrication, servicing, repair, and overhaul procedure. These should be obtained for reference and should be made a part of the operation and maintenance manuals. Review of historical service records will also be useful here, if available, to indicate points to inspect. Other sources of similar information include trade associations, and the experience of others with similar responsibility.

How Often To Inspect

Frequency of inspection, adjustment, service, and overhaul depends upon many factors and must be adjusted to suit local needs and experience. Manufacturer's manuals, and published reports of the procedures of others are excellent guides, but these are for average conditions and must be adjusted to fit local conditions. The frequency for a given machine may include daily, weekly, monthly, and annual inspections of certain points. In analyzing the frequencies required consider the effects[8] of the following:

- Age, condition, value — The older the equipment or a system becomes, the more frequent the inspections are that are necessary until it is determined the item has passed its useful life expectancy and is ready for replacement.
- Severity of service — This can only be determined by functional use. The more severe the use the more frequent the inspections.
- Safety requirements — Inspect on the safe side — more frequently than normally required.
- Hours of operation — Adjust inspections according to operating time. Round the clock operation requires more frequent surveillance than eight hour a day operation.
- Reliability — If a system must operate without breakdown because production depends on it, more frequent inspections are required.
- Exposure to dirt, friction, corrosion — Equipment susceptible to wear under these conditions must be inspected more frequently.
- Damage through abuse — Equipment exposed to overloading, vibration, and other hard usage requires more frequent inspections. Engi-

neering changes may also be in order if repetitive repairs are excessive to eliminate the basic cause of breakdown.

- Adjustment requirements — What will be the effect of maladjustment or misalignment?

Update Frequencies for Economy

The initial estimates of frequency are needed to schedule the work. They should not become sacred, however, and allowed to remain static unless evaluation shows they are satisfactory in all respects. As experience is gained and data collected, frequency cycles should be reviewed to assure both adequate and economic inspection. Some cycles may be excessive, while repeated breakdowns indicate others are not made often enough. Compare inspection costs with costs of unscheduled repairs and value of equipment to achieve an economic balance.

Estimate Manhour Requirements

The next step in planning is to estimate the time required for each inspection, adjustment, service established for each equipment item. Times for various operations that can be used as guides are suggested in manufacturer's manuals. These are average times and they must be adjusted in accordance with local conditions and experience. Time estimates in conjunction with frequency of inspection determine total manhours required and are indispensable in scheduling the maintenance work and determining the size and character of the maintenance force required.

Due to the many variables in maintenance work, application of industrial engineering techniques to establishing time standards for various operations has only recently been attempted. Also, methods of work simplification have only recently been studied. Before applying industrial engineering methods, however, a basic management program is essential. Once a basic management system is put into effect, improvement in work methods and more realistic time standards will develop with a little effort in evaluating the records available.

Determine Skills Required

Up to this point, only the physical plant and its needs in the controlled maintenance program have been considered. The personnel available for maintenance are also vitally important — in fact, their capabilities and attitudes determine the success or failure of a controlled maintenance program.

At this point it is well to take inventory and evaluate the personnel assigned to maintenance. Some of the questions to be answered[5] include:

- Are the men competent?
- What are their weaknesses?
- Where do they excel?
- Is the staff adequate to meet the requirements?
- Do the men need additional training?

Some divergence in approach to staffing problems would be anticipated for heating, piping, and air conditioning installations in industrial plants, and in commercial and institutional buildings. In industrial plants where maintenance of utilities is but a part of the total maintenance burden, the work force must be integrated in the total maintenance personnel organization. Large and small industrial plants have different problems, too. While wide variations in organization exist in industrial plants, a special crew is often assigned to heating and air conditioning maintenance. Their work is supplemented by other crafts when necessary.

For example, in the Wichita plant of the Boeing[9] Airplane Co., maintenance employees are assigned to operate and maintain the 67 year 'round air conditioning systems which operate an average of 16 hours per day, nine months of the year. Because of the critical nature of the air conditioning system and the need for efficient operation at all times, routine patrols are made on the equipment.

Boeing Assigns Men to Machines

At Boeing, each man is assigned to specific machines to promote maximum familiarity of the operator with his equipment and to make possible the delegation of responsibility and authority. These men perform all major overhauls and make minor repairs to any system including those needed on cabinets, fixtures, housings, fans, etc. Major repair and overhaul of the latter components is handled by the appropriate maintenance skills. Thus, in this instance, the personnel assigned to the year 'round systems are responsible for both operation and maintenance and are particularly skilled in maintaining the refrigeration components of the system.

Operators Maintain Central Plants

For contrast, consider the system employed[10] by the McDonnell Aircraft Corp. This system is comprised of a number of boiler plants providing heating and process steam and air conditioning. A central power plant also provides heating for several buildings in the complex. Here, 100 people are employed to operate and maintain the system. In each of the central plants requiring continuous attendance by operating personnel, scheduled preventive maintenance is carried out by the operating crews. Other equipment not under continuous surveillance is inspected daily by "operating maintenance men." When necessary, specialized maintenance crews are utilized or additional manpower is obtained from a central maintenance pool.

Need Versatile Crew in Small Systems

In other installations such as hospitals, commercial buildings, etc., the organization will be smaller in size and slightly different in character as it must be more versatile. In planning the maintenance force for such an installation, the procedures[11] followed in establishing the maintenance force for the home office of the Nationwide Mutual Insurance Co. should be helpful. The office building was constructed in 1948 at a cost of some $6 million. The mechanical equipment was valued at about $2 million when installed. The first step in determining the staff required to operate and maintain this building was to estimate the time required to perform each of the preventive maintenance inspections required, as noted earlier.

How Many Manhours Available?

The next step in the Nationwide plan[11] was to estimate the productive time of each man on an annual basis. Starting with a theoretical 2080 hours per man per year based upon a 40 hour week, this was reduced by taking into consideration several factors as follows:

1) Each man has a regular 2 week vacation which reduces available time 80 hours.

2) Average sickness and other absence was assumed to be 40 hours.

3) Special construction and other projects were estimated at 15 percent of the total work or 300 hours per man. This will vary with company policy and the nature of the operation and must be adjusted to local requirements.

4) Five paid holidays reduce available time 40 hours more.

5) An 80 percent efficiency going between jobs, getting material, preparing the job, etc., was assumed.

The total hours available per man are then 1620 (2080 — items 1, 2, 3, and 4) and an 80 percent efficiency reduces this to only 1296 actual hours per man available for productive work.

To see how this works assume the total number of hours required for maintenance and repair amounted to 32,000 hours. This, divided by the 1296, would indicate a tentative required staff of 24 men. The construction work, which in the example above, was estimated to be 15 percent may differ, too. In some plants it may be as much as 25 to 30 percent or there may be none at all. It would be well to note here, however, that when new construction becomes too large a part of the burden, maintenance suffers. In such instances, separation of the maintenance and construction crews is considered desirable.

What Skills Are Needed?

The estimates of time required to perform scheduled inspections, repairs, etc., will indicate the types of skills required, as well as the total number of men needed. The next step taken for the Nationwide building was to write complete job descriptions for each craft or trade. Typical examples of job descriptions are given below. While these may not apply to other installations without modification, they suggest a form and content for job descriptions that should prove helpful.

In this case, the operating engineers are responsible for the heating, air conditioning, and ventilation equipment. Pipe fitters under the

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JOB DESCRIPTIONS LIKE THESE REFLECT RESPONSIBILITIES OF EACH CRAFT

Senior Operating Engineer

Objective:

Make daily major adjustments and changes in control devices on the heating, ventilating, and air conditioning equipment as conditions warrant for maximum operating efficiency and comfort.

To coordinate the major and seasonal maintenance and overhaul of all mechanical equipment in all home office buildings pertaining to heating, ventilating, and air conditioning; and the installation of new equipment or repair parts pertaining to same.

Scope:

Helps coordinate the installation of new heating, ventilating and air conditioning equipment and interprets blueprints, plans and specifications to this end.

Makes major changes, adjustments or repairs as indicated from instrument readings and from the daily logs to boilers, pumps, fans, refrigerator compressors, control devices to maintain comfort conditions throughout the buildings.

Seasonally dismantle, clean and adjust and replace parts as required on boilers, vacuum pumps, refrigerating compressors, cooling towers, and fans.

Makes weekly combustion tests during the heating season to assure the efficient use of fuel and makes necessary adjustments to achieve this.

Recommends the carrying of an adequate stock of material, supplies and emergency replacement parts for the heating, ventilating, and air conditioning equipment.

Experience:

Must have Ohio State steam engineer's license, minimum five years experience in large power, heating, and air conditioning plants. Must have thorough knowledge in the operation and construction of boilers, high pressure steam, large compressors, and ventilating systems. Able to read blueprints, know heating, ventilating, and air conditioning control systems.

Unusual working conditions:

There are hazards involved in working on high pressure steam, gas, oil, and air equipment. Sound judgment is necessary in operation and making repairs on this equipment to prevent injury to self, to others or equipment breakdown affecting large areas of operation pertaining to heating, ventilating, and air conditioning.

Remarks:

May work any shift, day or night. Subject to dirt, dust, extreme heat and cold, carry heavy equipment and tools. Cover all areas of building operation making adjustments or repairs for heating, ventilating, or air conditioning. Meet executives on all levels.

Senior Maintenance Engineer

Objective:

To coordinate installation and repair of all plumbing fixtures; hot water generators; drinking water fountains; cafeteria refrigerators, conveyors and food processing equipment; fire hydrants and extinguishers; and water pumps.

Conducts regular weekly preventive maintenance schedules of all equipment and makes adjustments, repairs, or replaces parts as necessary.

Scope:

Makes daily tests, repairs and adjustments on cafeteria deep freeze and refrigerating equipment to maintain correct temperature.

Replaces hot and cold water lines, sewer piping and fittings; employs gas or electric welding or sweating as required.

Repairs or replaces plumbing fixtures, lavatories, toilets, valves and faucets.

Coordinates the installation of new equipment, and follows blueprints, plans and specification to this end.

Installs fire sprinkler systems, hot water and gas heating equipment.

Makes weekly preventive maintenance inspection tests on all sanitary plumbing equipment and of all hot water and gas generating equipment and makes adjustments, repairs or replacements as needed.

Experience:

Must have Ohio State steam engineer's license; five years experience in heating, power and refrigeration plant; knowledge of domestic and commercial refrigeration; pipe fittings; plumbing and welding.

Unusual working conditions:

Hazards involved in working on high pressure steam, oil and air equipment. May work any hour, day or night. Subject to conditions of dirt, dust, extreme heat or cold, and carry heavy ladders and equipment.

Remarks:

Sound judgment required in dismantling and making repairs on sanitary plumbing lines, high pressure gas lines, hot and cold water and sewer repairs and replacements.

Often meets executives on all levels. Work affects large areas of building operations.

These job descriptions are from the operation and maintenance manual[12] of the Nationwide Mutual Insurance Co. Similar descriptions for shift operating engineers and maintenance engineers outline their responsibilities.

title "maintenance engineer" are responsible for all piping as well as plumbing fixtures and small refrigerating units. Electricians are responsible for electric motors used in the heating and air conditioning system as well as all other electrical equipment.

Schedule Work for Best Results

The primary objective of the preceding steps was to collect sufficient information for scheduling the work. This is essential to make most efficient use of the work force and to insure a high degree of performance from the maintenance program.

The next step is to place the system in operation. First, it must be decided who is to do what and when they are to do it. Of course the preventive maintenance program must be sold to the employees first and most importantly[5]. In this process, it should be pointed out that the preventive maintenance program will mean easier and more interesting work. Also, through this program they can take pride in the systems for which they are responsible.

What Kind of Schedule?

In making up schedules the engineer must be aware of his responsibility to the user to keep equipment in working condition when needed. Schedules should be developed with this in mind. It is recommended that:

a) as much of the inspection and maintenance work be scheduled as possible on low or non-use hours,

b) the maintenance load be distributed throughout the year,

c) the day shift be used as much as possible to keep overtime to a minimum.

Some of the fundamentals that should be considered in making the preventive maintenance schedule are:

- Should every item be scheduled? Yes.
- What should be done when a schedule is not completed on time? If the delay is bad, issue a special work order.
- How can work be scheduled on a 24 hour, 7 day week operation? If the preventive maintenance program is to be successful, there is no way but to arrange for the most convenient time and adhere to it.
- A successful program of preventive maintenance cannot be achieved if it is allowed to be interrupted.

Records Should Be Adequate But Simple

Simultaneously with the taking of the plant inventory, a record should be made of the things that are found. This leads to a discussion of the paper work involved and ways that it can be accomplished. Many factors affect the way records are kept and how complete they must be. In any case, the records should be adequate to provide the degree of control required but as simple as possible to avoid over burdening the maintenance force with clerical duties. The records should work for the supervisor and not make more work for him.

Perhaps the greatest variation between maintenance management systems is in the forms on which the necessary and useful information is recorded. These may range from manual methods of posting to the use of electronic data processing equipment, from 5 x 8 in. cards to printed forms, and from one to several cards. Regardless of method, the information recorded is the same. Some of the basic forms used and what they contain are given below. It should be remembered that these cover primarily the information that is recorded and they can be used in composite forms or individually or not at all as dictated by the situation.

System Card Carries Design Intent

In some instances a system card[6] — an installation record-card — lists all equipment associated with a particular installation. It also gives descriptive information about the design condition and other operating data such as the system location, its name, the installer, and the date installed. This card would supplement an operation manual with pertinent design facts readily available. A schedule of the preventive maintenance to be performed is also included.

This form is used primarily for recording maintenance costs not associated with or directly applicable to any piece of equipment, i.e. costs of valves, traps, ductwork, painting, cleaning, and piping maintenance would appear on this record. Cost comparisons of systems can readily be made from such a card.

Equipment Records Aid Cost Studies

The vital statistics of each major piece of equipment, such as compressors, pumps, fans, motors, etc. are listed on the equipment record card. This is one card common to all systems and on it the following are listed:

- Nameplate data
- Cost
- Purchase date
- Location
- Voucher
- Record of repairs and overhaul costs

In addition to the above data, it is sometimes found convenient to list on this card the schedule of preventive maintenance, spare parts requirements, spare parts inventory, and depreciation

A performance record of each principal equipment item is obtained on this form. These are useful in comparing like equipment of different manufacture and in indicating weaknesses in a particular design should they exist. The record of non-scheduled repairs will also expose weaknesses in preventive maintenance schedules and procedures. This record is an important tool for successful maintenance management without which the program cannot be improved to achieve maximum benefits.

What the Maintenance Card Does

In some instances, the schedule[5] of preventive maintenance and the record of maintenance performed is listed on a separate form — the maintenance card. These can be duplicated by various means of reproduction for use by the mechanic during each inspection. This gives him all of the things he needs to know or refers him to a source of information. In addition, it lets him know what changes or repairs were made on the previous inspection.

Charts and Cards Used With Success

The chart and card system[10] has been used with success at the McDonnell Aircraft Co. Each area requiring continuous attendance by operating personnel uses a chart system which lists each piece of equipment and the maintenance operation which is to be performed. Also included is the frequency of performance.

All other equipment — that whose operation is not supervised 100 percent of the time — is indexed on a "cardex" system. When new equipment is installed, all operating and maintenance procedures are reviewed and put on cards. These cards come up at predetermined intervals and are sent to responsible departments for their prescribed actions.

The preventive maintenance system is set up at the McDonnell Aircraft plant so that major overhauls on air conditioning equipment are performed during the winter months. Likewise, major heating equipment overhauls are done during the summer. This assures that vital equipment is in peak operating condition during critical operating periods.

Preventive maintenance "traveler" cards are sent to responsible supervision on a predetermined frequency, indicating what maintenance work is to be performed at the McDonnell plant. Periodically, inspections are made to insure that the work is completed as scheduled.

Histories are kept of each piece of equipment. These are reviewed periodically for unusually high cost items, repetitive repairs, or other factors which might indicate that engineering action is needed to reduce costs or improve performance. These histories may also dictate changes in frequency or the scope of the preventive maintenance schedule on individual pieces of equipment.

That this maintenance procedure has paid off is borne out by the fact that in 17 years the plant has never been without steam.

Training Maintenance Personnel

Several approaches can be used to train personnel for the preventive maintenance program. Formal classes where the standard procedures are covered as lessons over a period of weeks are excellent[5]. In addition to procedures, the instructor can and should cover the basic theory necessary for each man to understand how and why equipment functions. This will include chemistry of combustion, feedwater treatment, elementary thermodynamics and hydraulics, as the minimum. Formal classes should always be considered for a new installation even though the operating crew have had previous experience.

When formal classes cannot be conducted, training may be achieved on an informal group basis, with the men assigned to a shift, for example. Assume that a new piece of equipment has just been installed. This method of training would be applied by having the men assembled around the machine for the purpose of explaining the functions of the equipment, how to operate it properly, what to do, and what not to do. If possible, have the trainee start the unit, run it under load, then shut it down. Then in front of the group the shift foreman instructs the operator, the operator the helper, and the last man teaches the instructor. The men learn by hearing, seeing, doing, and teaching. This system has the advantage of providing a check on how well each man understands the information presented.

Personal instruction of a man by another employee or a member of the supervisory force is probably the usual method of training. This personal instruction is satisfactory, providing some method of checking on the trainee's progress is mandatory. The main disadvantage of individual instruction is the lack of personal control by the supervisor. Manufacturer's operating and service manuals and articles in technical magazines furnish another vehicle for training. Any material the men can read and apply should be available to them. Self instruction can only complement other methods, never supplant them. Service schools, conducted by equipment manufacturers, are valuable for specialized training of key men. If the men cannot be sent to these service schools, it is wise to encourage the manufacturer's servicemen to assist in training whenever they are in the plant or building.

Many organizations conduct courses the men can take on a voluntary basis. The extension divisions of many colleges and universities, night schools and correspondence courses all offer opportunities for self improvement.

Regardless of the plan or plans employed to train the men for this preventive maintenance program, the instruction should cover the following:

- What is expected of the man.
- How the work should be done, or the methods to be followed.
- When should each job be done.

Best results will be obtained only if each man understands why the job must be done, why in a particular manner, and why at a given time or in a given interval.

[This discussion of preventive maintenance of heating, piping, and air conditioning systems will be continued in future issues. The editors gratefully acknowledge the assistance of the engineers and organizations who permitted reference to their papers.]

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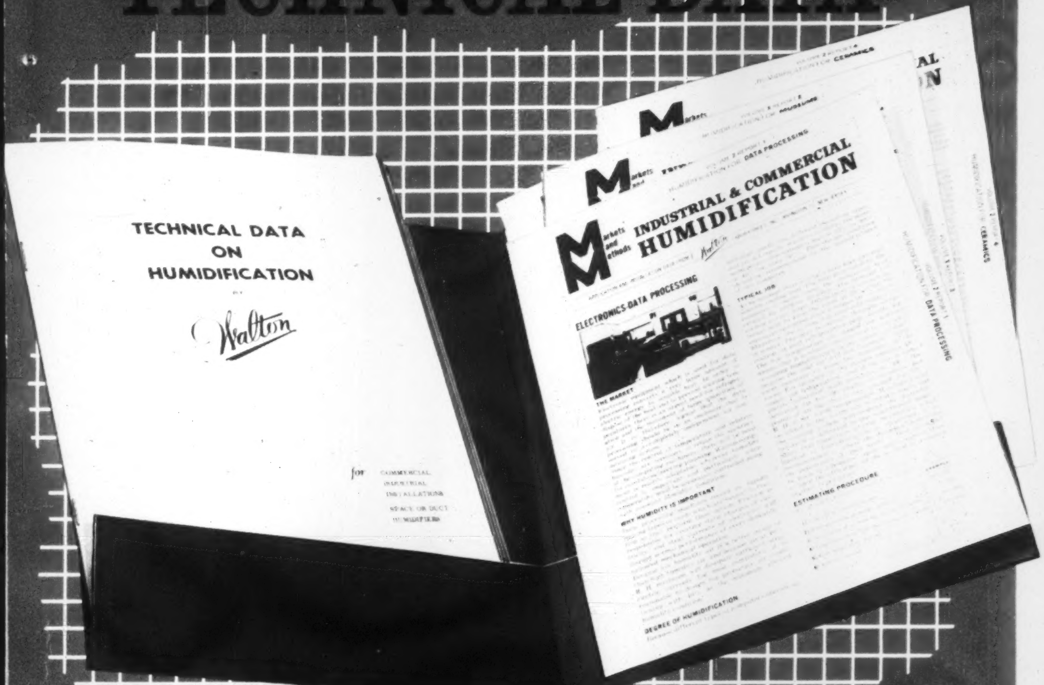
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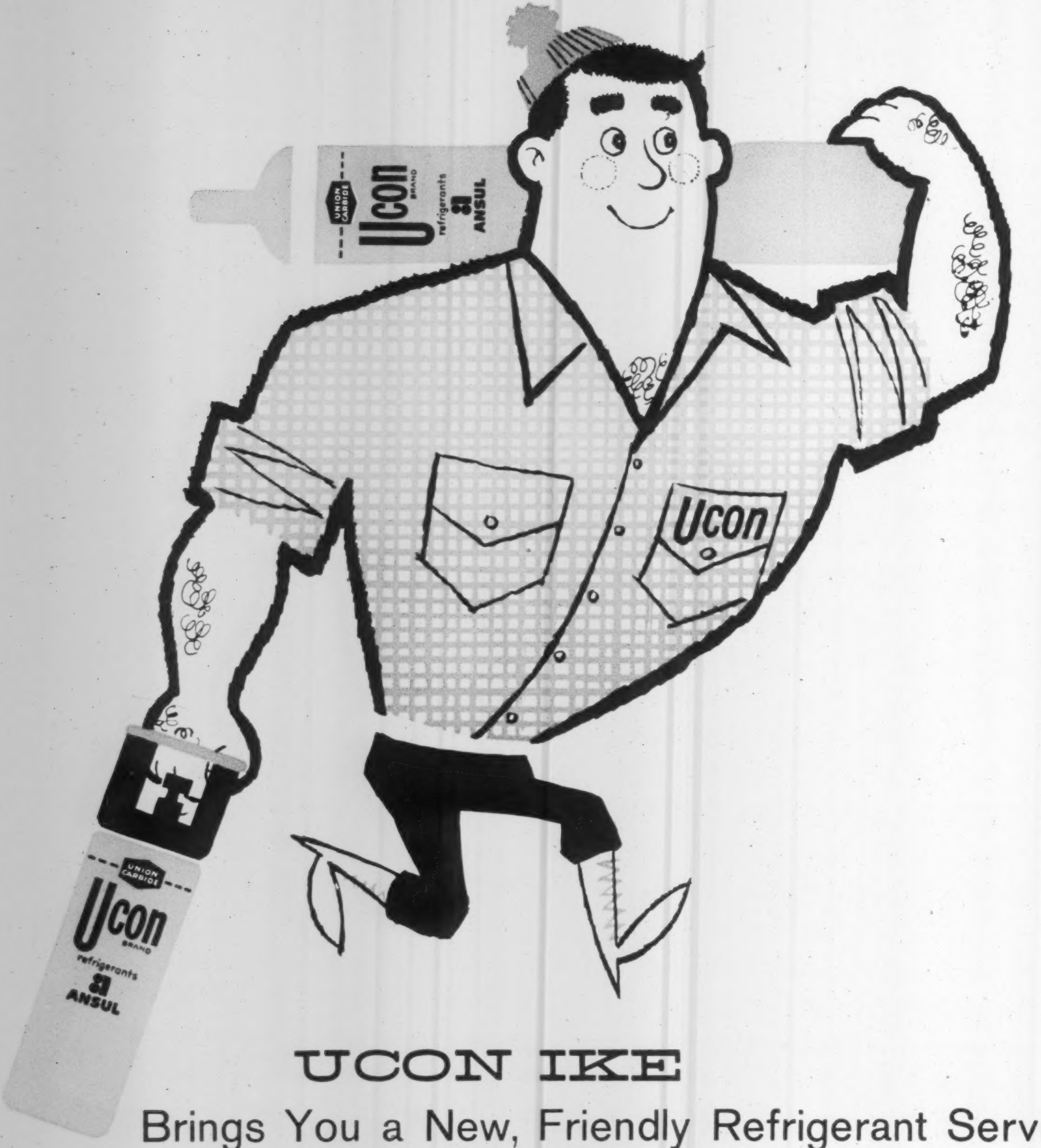

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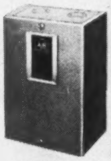

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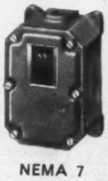

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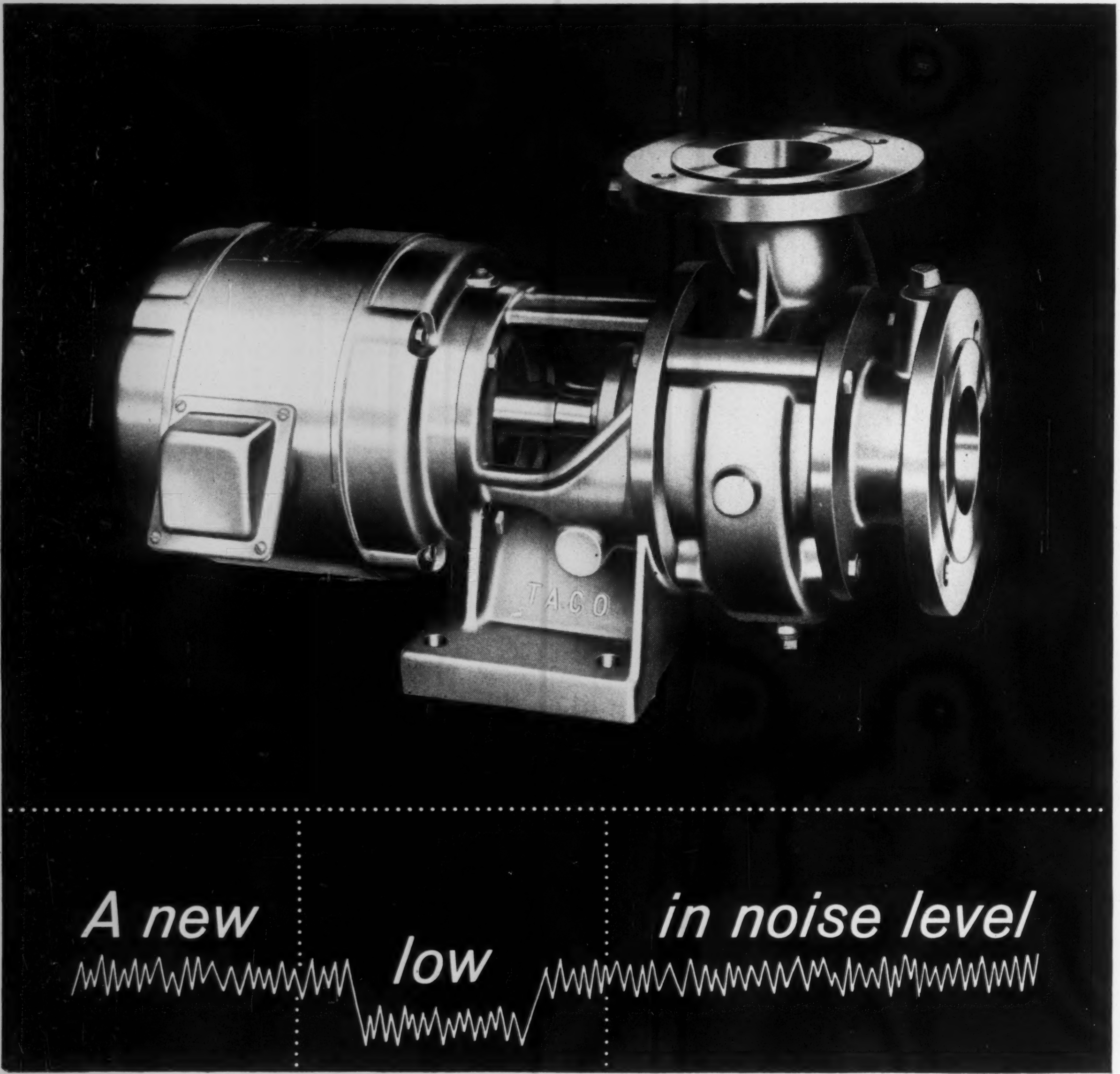

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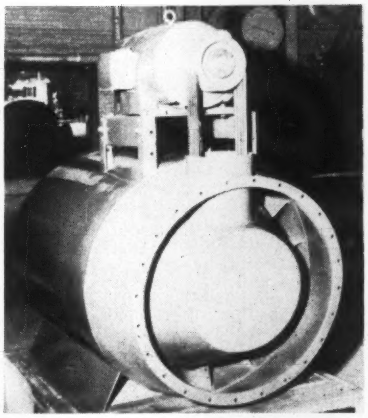
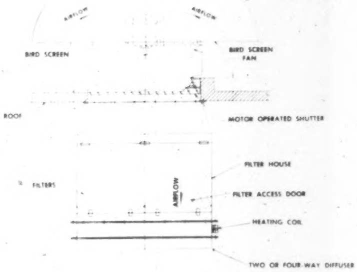


Centrifugal Fan . . .

. . . with straight line air flow to conserve space; unit can hang from ceiling, be mounted on wall, or stacked one above the other; available in six sizes, with airfoil wheels from 27 to 44½ in. in diameter; heavy steel all welded casing; volumes range from 4700 to 46,800 cfm with static pressures up to 9 in. of water gage — *Westinghouse Electric Corp., Sturtevant Div., Boston 36, Mass.*

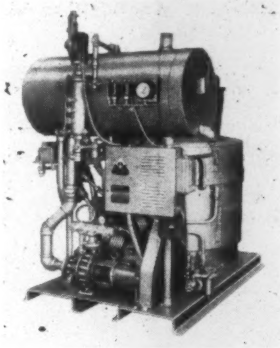


Air Intake Units . . .

. . . vertical discharge units have capacity range from 4000 to 36,000 cfm; steam coil produces Btu capacity (at 5 psi steam pressure) from 380,000 to 2,642,000 Btu per hr; shutters, steam coil, filter house and outlet diffusers can be added to black-out type roof ventilator fan housing when needed — *Hartzell Propeller Fan Co., P.O. Box 909, Roosevelt Ave., Piqua, O.*

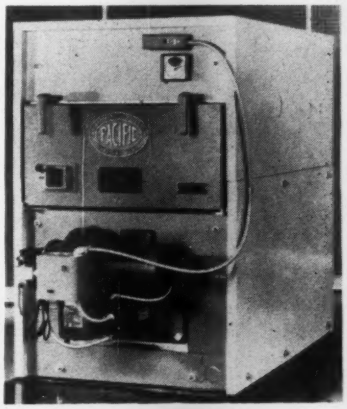
Pipe Bender . . .

. . . for 1¼ through 4 in. aluminum or steel conduit and pipe; optional parts allow 90 deg one-shot bending ½ in. through 2 in., and thin-wall bending ¾ in. through 2 in.; powered by two-speed, 10,000 psi hand pump, or with power pump; ram develops 27 tons of pressure — *Greenlee Tool Co., 2136 12th St., Rockford, Ill.*



Steam Boilers . . .

. . . low, medium, and high pressure units ranging from 10 to 200 bhp; pressures to 1000 psi; full output in five minutes, or instant hot water, from cold start; modulates automatically; drum principle prevents thermal shock; bulletin 4013 available on request — *Vapor Heating Corp., 80 E. Jackson Blvd., Chicago 4, Ill.*



Packaged Boilers . . .

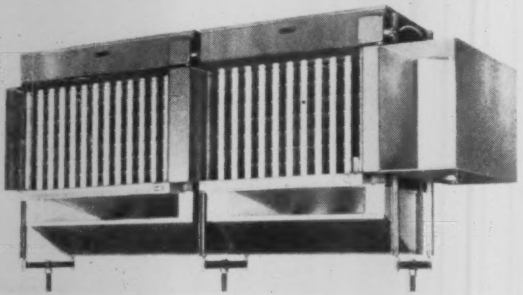
. . . for forced draft firing with oil, gas or combination oil/gas; available in seven sizes from 324 to 1800 M Btu per hr SBI gross output; bulletin "APJ-0025" describes units designated "Pacific '400' Series" — *Pacific Steel Boiler Div. of Crane Co., 944 Ash St., Johnstown, Pa.*

Control Panels . . .

. . . feature transistorized amplifier for longer life expectancy; power consumption and heat radiation kept at minimum — *Minneapolis-Honeywell Regulator Co., Commercial Div., 2747 Fourth Ave. S., Minneapolis 8, Minn.*

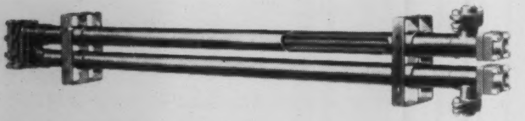
Thermal Insulation . . .

. . . for piping and other equipment, withstands soaking heat up to 1800 F indefinitely; calcium silicate compound combined with asbestos fibres and other materials — *The Ruberoid Co., 500 Fifth Ave., New York 36, N.Y.*



Sectional Duct Furnaces . . .

. . . gas fired, individual models up to 300,000 Btu per hr; can be close-coupled for higher capacity; available with either aluminized or stainless steel heat exchangers, and may be used with all common gases as well as dual-fuels; stainless steel condensate shield assembly available; bypass sections, enclosed blower assemblies, modulating gas valves, two-stage gas valves, also available — *Hastings Air Control, Inc., 3215 Leavenworth St., Omaha 5, Nebr.*

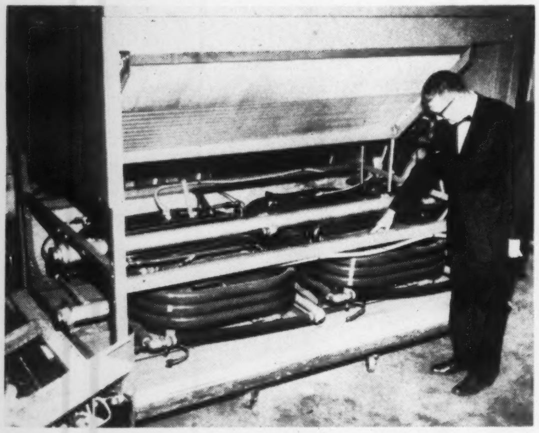


Heat Exchangers . . .

. . . multi-tube, double pipe units for handling light fluids with high heat transfer characteristics; four studs make up head-to-tube closure and tubeside joint; overall length of sections varies from 11 ft. 5 in. to 26 ft. 9 in.; width is 10 in., height 16 in.; seven fintubes contained in each 4 in. shell; fins on ⅞ in. OD tubes ¼ in. high; units available with unfinned tubes; specifications available on request — *Brown Fintube Co., 300 Huron St., Elyria, O.*

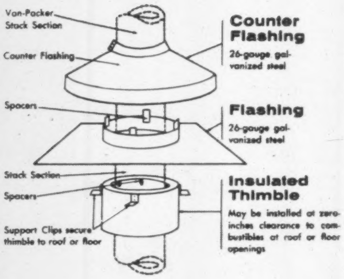
Pipe Plugs . . .

. . . lightweight plugs seal tightly without sealing compound; vibration resistant; made of Du Pont "Delrin," plugs are usable with all types of organic fluids; used in compressors, pumps, gas and water meters, and similar products; available in ⅛, ¼, ⅜, and ½ in. sizes in square heads; ⅛ and ¼ in. sizes in hex heads; withstood from 3000 to 10,000 psi in pressure tests — *Russell, Burdsall & Ward Bolt and Nut Co., Dept. D, 100 Midland Ave., Port Chester, N.Y.*



Packaged Air Conditioner . . .

. . . employs four hermetically sealed compressors, utilizes four-step starting under all conditions to permit low inrush starting current; compressors are placed on line only as demand increases, unit is of 33.3 tons capacity, for up to 15,000 cfm air flow at normal duct pressures; with 7½ or 10 hp fan motors —*York Div., Borg-Warner Corp., York, Pa.*


Van-Packer Stack Section
Counter Flashing
Spacers
Stack Section
Spacers
Support Clips secure thimble to roof or floor
Counter Flashing
26-gauge galvanized steel
Flashing
26-gauge galvanized steel
Insulated Thimble
May be installed at zero-inches clearance to combustibles at roof or floor openings

Smokestack Components . . .

. . . insulated thimble, flashing, and counter flashing available with firm's model "HT" smokestack; allows zero in. clearance to combustibles at roof or floor openings; available for the eight sizes of stack firm offers, ID of 10, 12, 15, 18, 21, 24, 30, and 36 in.; bulletin IS-49 available on request — *Van-Packer Co., Div. of The Flintkote Co., 30 Rockefeller Plaza, New York 22, N.Y.*

US RUBBER **EXPANSION JOINTS**

How to keep your cost accountant contented

Just ask him to amortize the cost of a U.S. Rubber Expansion Joint.

He will have a pleasant time discovering that these joints never seem to wear out. Some have been in use for 30 years and are as sturdy as ever. No other rubber expansion joints have been in use that long.

"U.S." Expansion Joints are the only joints that have withstood this test of time. As for value, "U.S." Expansion Joints remain the cost accountant's delight. Other so-called "just-as-good" joints costing a few dollars less can rob you of many times their complete cost when they cause downtime.

Your accountant will tell you that "U.S." Expansion Joints comprise shrewd, logical insurance. These joints are the economical, flexible connections used in all kinds of pipe lines to take care of misalignment, vibration, expansion, contraction and noise transmission. No moving parts to wear or bind; can be installed on new or old equipment.

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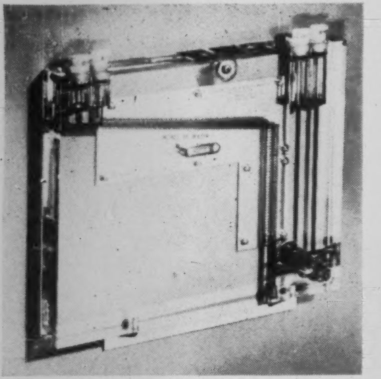


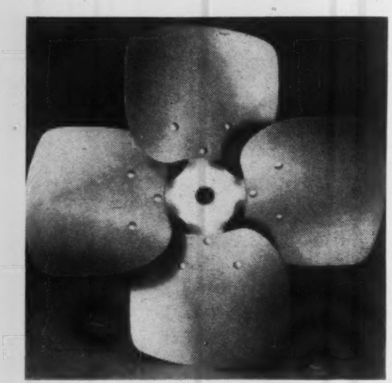
Manometers . . .

. . . inclined-vertical unit designed for use with pitot tubes and for flow measurement; available in single and double column styles, stationary or portable, in various ranges up to 23 in. of water gage; accurate within ±1 percent; ground glass spirit levels on all models; rapid shutoff type molded nylon gage connectors standard, other styles optional; bulletin B-75 available on request — *F. W. Dwyer Mfg. Co., Dept. HA-8, P.O. Box 373, Michigan City, Ind.*

SWAGELOK
NUPRO
SWAGELOK

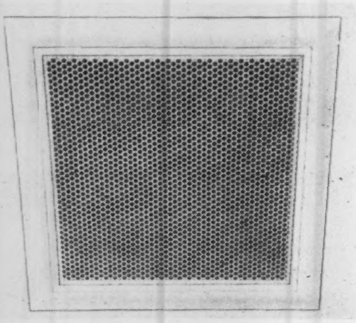
Check Valve . . .

. . . poppet type in ⅜, ½, and ⅝ in. tubing sizes for use in instrument, process, and control lines or in fluid service lines to prevent system contamination; provides large flow areas for minimum pressure drop, incorporates turbulence rings to provide stability and rapid shut-off; valve seat is formed of rubber for bubble tight sealing at low back pressure, body seal is also rubber; available in type 316 stainless steel and brass — *Nuclear Products Co., 15635 Saranac Rd., Cleveland 10, O.*



Propeller Fans . . .

. . . for unit heaters, air conditioners, window fans, evaporative coolers, and space heaters; available in diameters of 8, 10, 12, 14, 16, 18, and 20 in. — *The Torrington Mfg. Co., Torrington, Conn.*

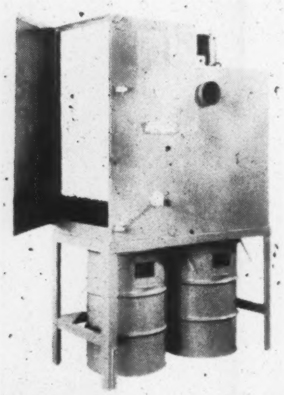


Ceiling Diffusers . . .

. . . supply and return units feature perforated plate on diffuser face to conceal mechanism and blend into acoustical ceiling tile; available in square and rectangular models in one, two, three and four way air patterns; surface or recessed mounting models in standard sizes; catalog "TPD-60" available on request — *Titus Mfg. Corp., Box 810, Hiway 20 West, Waterloo, Ia.*

Couplings . . .

. . . feature pan-shaped rubber flexing element designed for high speed or high torque applications; will accommodate either singly or in combination, angular and parallel shaft misalignment and end float; will absorb torsional vibration and cushion shock loads; one model mounts on shaft; one mounts on flywheel — *Dodge Mfg. Corp., 500 S. Union St., Mishawaka, Ind.*



Dust Collector . . .

. . . separator type, designed for machines producing wood, metal, or plastic dust, chips or shavings; 1200 cfm unit includes two 55 gal drums for filtered material; unit operates on 3 hp motor; clean air is returned to room without heat loss through 14 filter bags of flame and mildew-proof cloth; machine is 102 in. high × 60 in. wide × 30 in. deep — *Kindt-Collins Co., 12653 Elmwood Ave., Cleveland 11, O.*

Pipe Patch . . .

. . . thermosetting epoxy resin can be used on any diameter pipe operating at pressures up to 100 psi; designated "Scotchcast" brand electrical resin No. 4, material is not affected by hydrocarbons and most chemicals; primarily used for gas transmission and distribution lines, but can be used for liquid piping repairs and joining plastic pipe — *Minnesota Mining and Mfg. Co., Dept. WO-335, 900 Bush Ave., St. Paul 6, Minn.*

Descale

cooling towers, evaporative condensers, ice-making machines

easily, more safely with non-fuming Dry Acid Cleaners based on Du Pont Sulfamic Acid

EASIER TO USE

Just scoop dry acid cleaners from lightweight, disposable drums into make-up tank. Often can be added directly to equipment . . . no elaborate apparatus required.

SAFER TO HANDLE

These cleaners are dry, non-fuming powders. No danger of spilled or spattered liquids. No danger of corrosive or toxic fumes spreading throughout the building during servicing.

ECONOMICAL

1 lb. of dry acid cleaner does the job of 1.5 lbs. of hydrochloric acid. You'll save on shipping, handling and storage costs.

LESS CORROSIVE

Sulfamic acid is less corrosive than hydrochloric acid; on brass, 60% less; on steel—70%; copper—85%; aluminum—80%. And, with the proper inhibitor, it can be used safely on galvanized steel.

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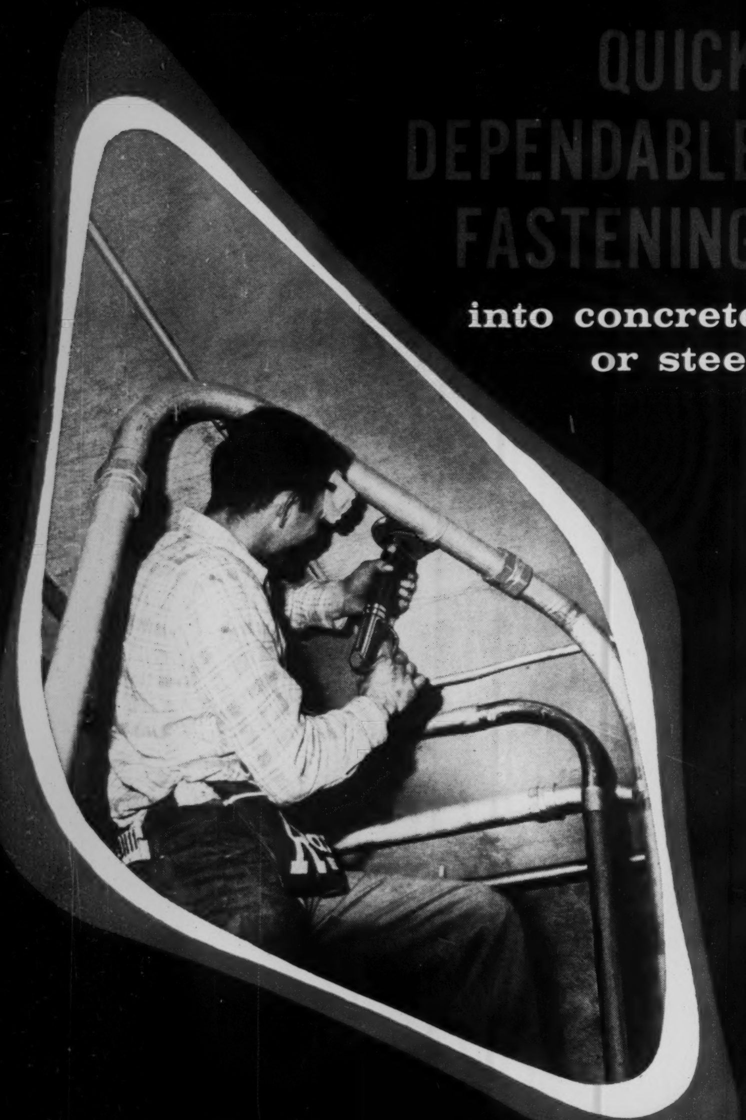
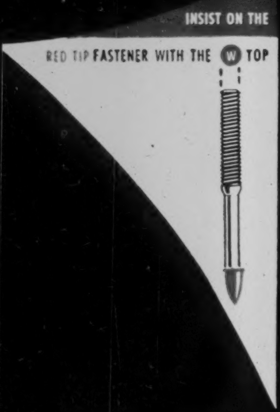
Leading contractors use Ramset for

QUICK DEPENDABLE FASTENING

into concrete or steel





INSIST ON THE
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Whenever plans call for fastening into concrete or steel, Ramset does the job in a split-second. Ramset powder-actuated fastening has proved far more efficient and economical than old-fashioned methods. With Ramset you're assured of quick, easy fastening, even under the toughest conditions . . . and every fastener is guaranteed!

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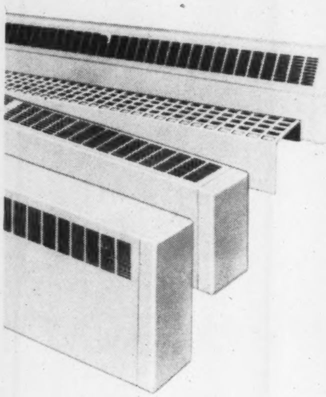
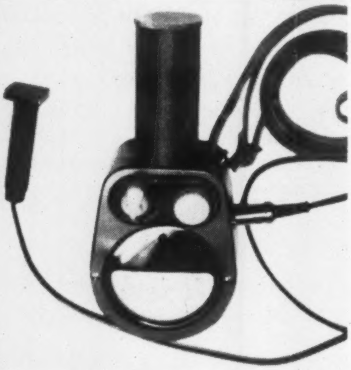


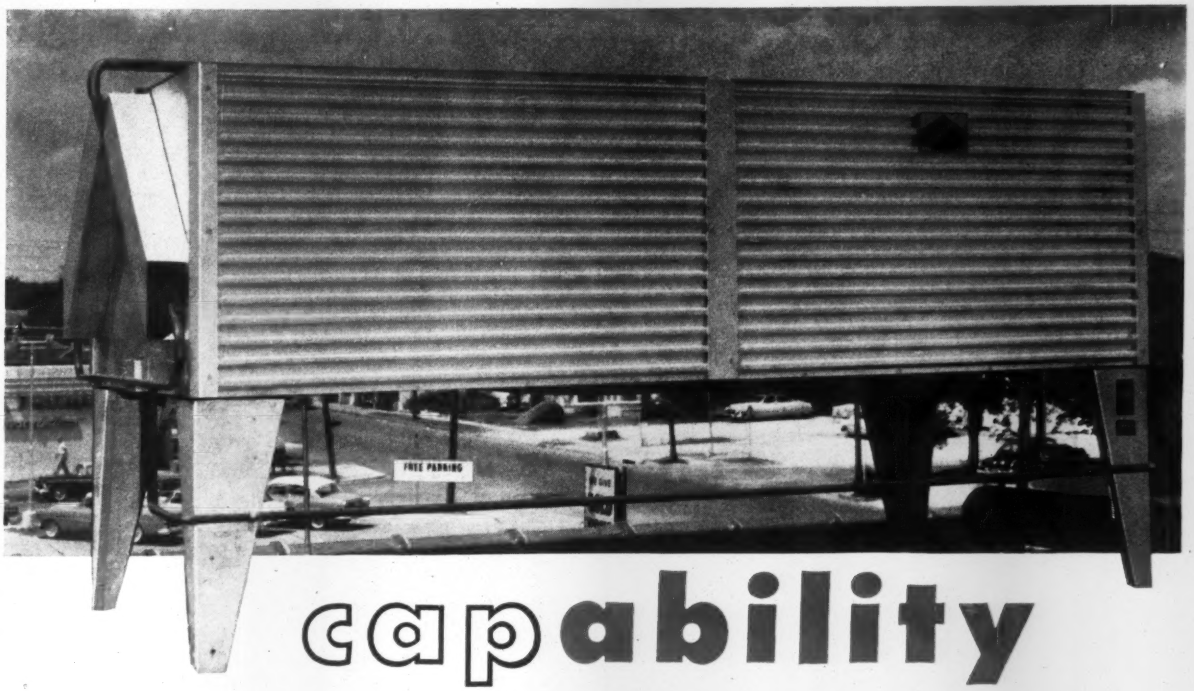
Finned Tube Radiation . . .

. . . available in two enclosure styles, standard and deluxe; standard units offered in 2, 3, 4, 5, 5½, 6, 6½, and 7 ft lengths; deluxe enclosure offered in increments of 4 in. from 24 to 100 in.; enclosure heights available to accommodate one, two, or three tiers of 3 and 4 in. finned heating element; heating elements consist of aluminum fins and annealed copper tubing; bulletin 460 available on request — *Modine Mfg. Co., 1509 De Koven Ave., Racine, Wis.*



Surface Probe . . .

. . . measures surface temperatures of tanks, tubes, pipes, cylinders, or rough surfaces; self-aligning contact surface assumes contour of surface surveyed; nickle resistance wire sensing element; for use with firm's resistance thermometers — *Gelman Instrument Co., 106 N. Main St., Chelsea, Mich.*

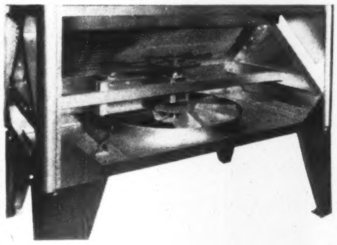


capability

stands out in

Marley Series B DriCooler®

AIR COOLED CONDENSERS



Ask the Marley Man (or write) for Bulletin DC-60 that explains why DriCoolers also have outstanding . . .

durability
adaptability
compatability
controlability

Series B DriCoolers have the capabilities that supermarket service demands. They are capable of 24-hour operation every day of the year; they are capable of delivering full performance year after year after year . . . prime requisites for profitably maintaining perishable inventory and providing equally important customer comfort.

These characteristics recommend DriCoolers to engineers who specify condensers for the largest chains, who also appreciate the plus-performance capability of every DriCooler model that assures capacity for peak loads at minimum investment. Store personnel endorse DriCooler engineered simplicity that makes maintenance a matter of minutes per year.

Available for all DriCoolers are the exclusive Marley Winter Control Damper and the Marley ADB Pre-Cooler. Equipped with the Winter Control System, a DriCooler is capable of rendering normal, stabilized performance during low dry bulb periods without attention or adjustment. The ADB Pre-Cooler adds the capability to handle unanticipated loads or to level off extremely high dry bulb temperature peaks.

U. S and Foreign Patents Pending

THE MARLEY COMPANY MARLEY KANSAS CITY 14, MISSOURI

DART
This True Ball Joint Makes the Difference

DARTS ARE THRIFTY ON THE POCKETBOOK

. . . TIGHT ON THE LINE!

Yes sir, Dart Unions cut costs because

1. They last longer — their two bronze seats are precision ground to a true ball joint.
2. They're easy and fast to install.
3. They *stay* tight — damage no property, spoil no work.
4. They can be used over and over again.

Which is why the answer to "How thrifty, how tight *can you get* is . . . GET DARTS"!

QUICK FACTS

- Leakproof because precision-machined to a true ball joint and spherically ground
- Shoulders are heavy — can take abuse
- Each Dart is individually vacuum-tested
- Bronze alloy seats are extra wide, resist pitting and corrosion
- Practically indestructible nut and body — of air-refined, high-test malleable iron

DART UNIONS *Products of* DART UNION COMPANY PROVIDENCE 5, R.I.

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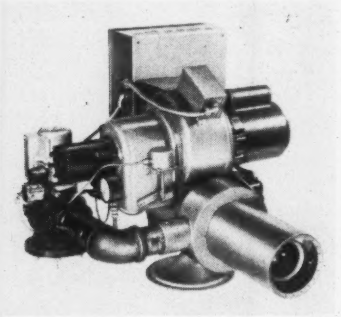
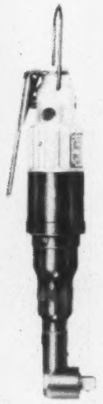


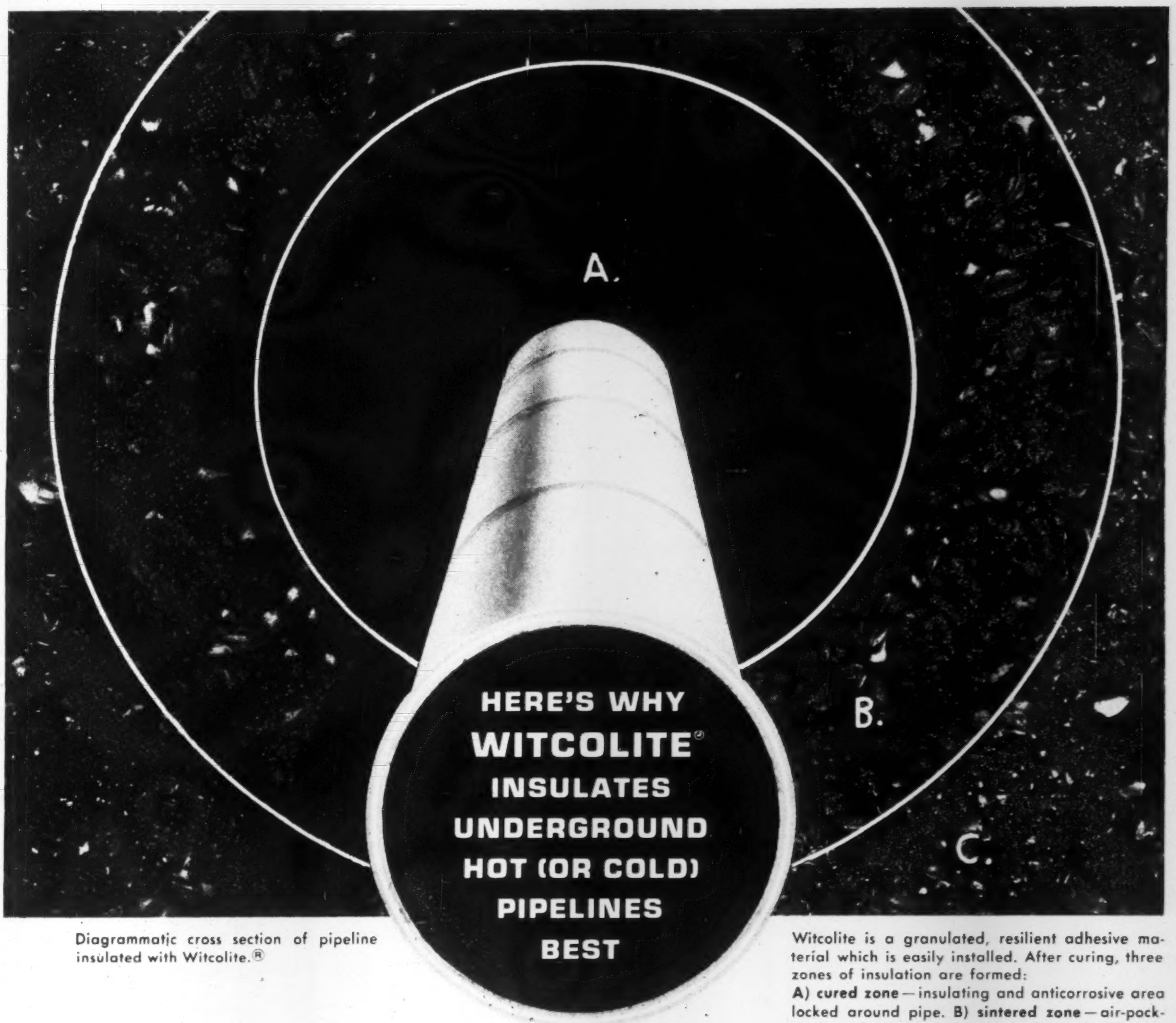
Pressure Burners . . .

. . . for installation in boilers and other process heating equipment; available in gas, oil, or dual gas/oil firing models; self-contained operating controls include electronic safeguard devices; capacity ranges up to 2,600,000 Btu per hr — *Roberts-Gordon Appliance Corp., 41 Central Ave., Buffalo 6, N.Y.*



Fastening Tools . . .

. . . 90 deg angle-head fastening tools for air-powered nutrunning and screwdriving; adjustable clutches for closer torque regulation; designed for continuous industrial operation where clearance is limited to ½ in. offset; available in speeds ranging from 600 to 3500 rpm, tools built in both reversible and non-reversible models; ratings up to ¼ in. machine screw; maximum weight 1-¾ lb; work spindles available include ¼ in. female hex, plain, and magnetic; and ¼ and ⅜ in. square drive — *Buckeye Tools Corp., 5003 Springboro Pike, Dayton 1, O.*



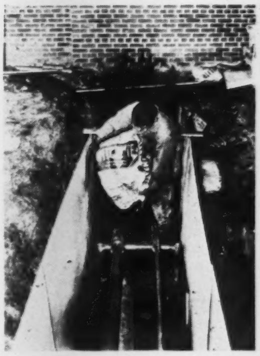
HERE'S WHY WITCOLITE® INSULATES UNDERGROUND HOT (OR COLD) PIPELINES BEST

Diagrammatic cross section of pipeline insulated with Witcolite.®

Witcolite is a granulated, resilient adhesive material which is easily installed. After curing, three zones of insulation are formed:
A) cured zone—insulating and anticorrosive area locked around pipe. **B) sintered zone**—air-pocketed insulating area... moisture barrier. **C) granular zone**—loose particles providing maximum thermal insulation.

WITCOLITE OFFERS ALL THESE ADVANTAGES

3 LABORATORY-CONTROLLED GRADES of granulated particle size assure perfect high thermal insulation of underground hot pipes... even with pipes alternately conveying hot and cold liquids. **HIGH THERMAL INSULATION** is the result of Witcolite's three zone protection. The product resists physical breakdown and adheres resiliently to pipes as they expand and contract with temperature changes. **HIGH CORROSION RESISTANCE** protects pipes permanently against acids and alkalis found underground. Witcolite is also effective against electrolytic processes. **HIGH WATER RESISTANCE,** results from the surface tension differential between water and Witcolite. No wetting of the underlying surface occurs. **LOWEST COST** of any quality material on an installed basis is an extra plus with Witcolite. *For further information or technical literature on Witcolite, simply write or call the nearest Witco office listed below for your local representative's address.*



Witcolite is delivered to your job site in convenient, easily handled 50 pound multi-wall paper bags.

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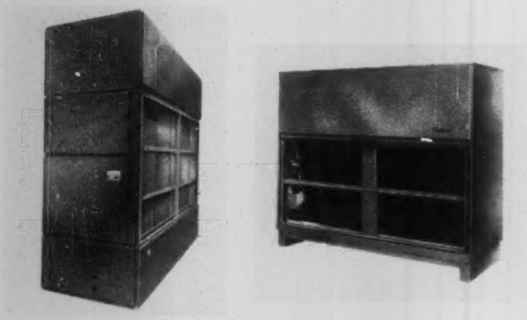


Air Conditioning Units . . .

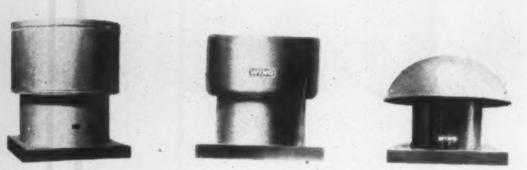
. . . nine packaged units ranging from 10 to 50 ton capacities; 10 ton indoor and outdoor heat pump sections; three 15 ton air-cooled condensing units; 15 and 20 ton direct expansion fan coil units; and 40 and 50 ton self-contained units — *Carrier Corp., Carrier Parkway, Syracuse* 1, *N.Y.*

Bearing Sealant . . .

. . . developed to restore fit between replacement bearings and worn housings in electric motor end-bells; sealant bonds brass, bronze, fiber or nylon sleeves, has a compressive strength in the range of 80,000 psi, can be used to set screws, and seal pipe and tubing joints — *American Sealants Co.,* 103 *Woodbine St., Hartford, Conn.*

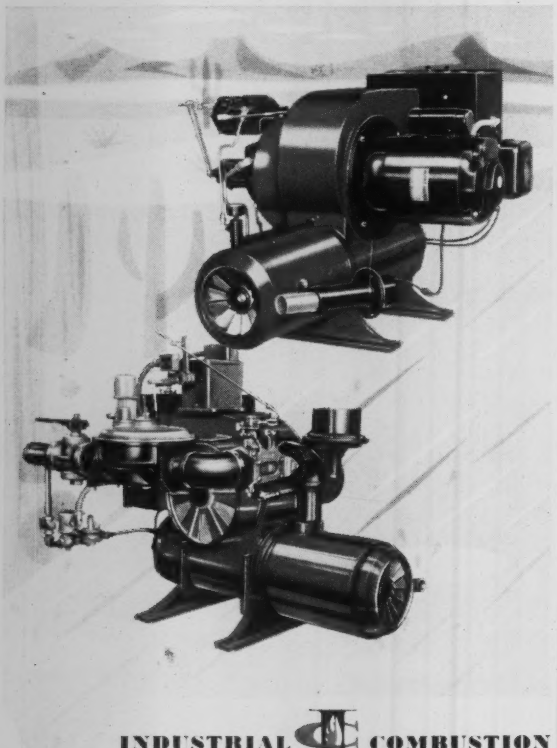
Flat-Tip Bit . . .

. . . for use with electric hammer to set anchors and expansion shields; drills holes with virtually flat bottoms; provides power bit rotation, special alloy steel shank, carbide tip; four sizes, all 8 in. long, for anchor bolt sizes 1/4, 5/16, 3/8, and 1/2 in. — *Skil Corp.,* 5033 *Elston Ave., Chicago* 30, *Ill.*



Power Roof Vents . . .

. . . available with choice of three interchangeable discharges: standard straight-through, decorative straight-through and mushroom; 10 fan and 12 motor sizes cover capacity range from 600 to 51,000 cfm; all-welded heavy-gauge steel construction with aluminum dampers, standard; aluminum or stainless steel construction, optional — *L. J. Wing Mfg. Co.,* 140 *Vreeland Mills Rd., Linden, N.J.*



These burners know no season

Perfect mixture of air and fuel gives perfect combustion in any weather

HEV-E-OIL BURNERS furnish *all* the air necessary for combustion. This assures perfect fire control regardless of the weather or draft conditions. *Exclusive* metering pump measures oil in proper proportion to air . . . assures highest possible efficiency and highest return from your fuel dollar. Once the burner is set, it *stays* that way rain or shine! Complete package! Fire tested! Meets all codes! Electronic controls! Models from 5 to 150 gph.

HEV-E-DUTY POWER GAS BURNERS also provide their own air supply — without the aid of chimney draft. Air is metered in correct proportion to the amount of gas being used. And like HEV-E-OIL BURNERS, minimum-low fire and maximum-high fire can be controlled exactly to assure top efficiency for each individual boiler or furnace installation. Set it! Forget it, no matter what the weather. Sizes from 720,000 to 21,000,000 Btu. Also combination gas/oil models. Write Dept. HPA-100 for complete facts.

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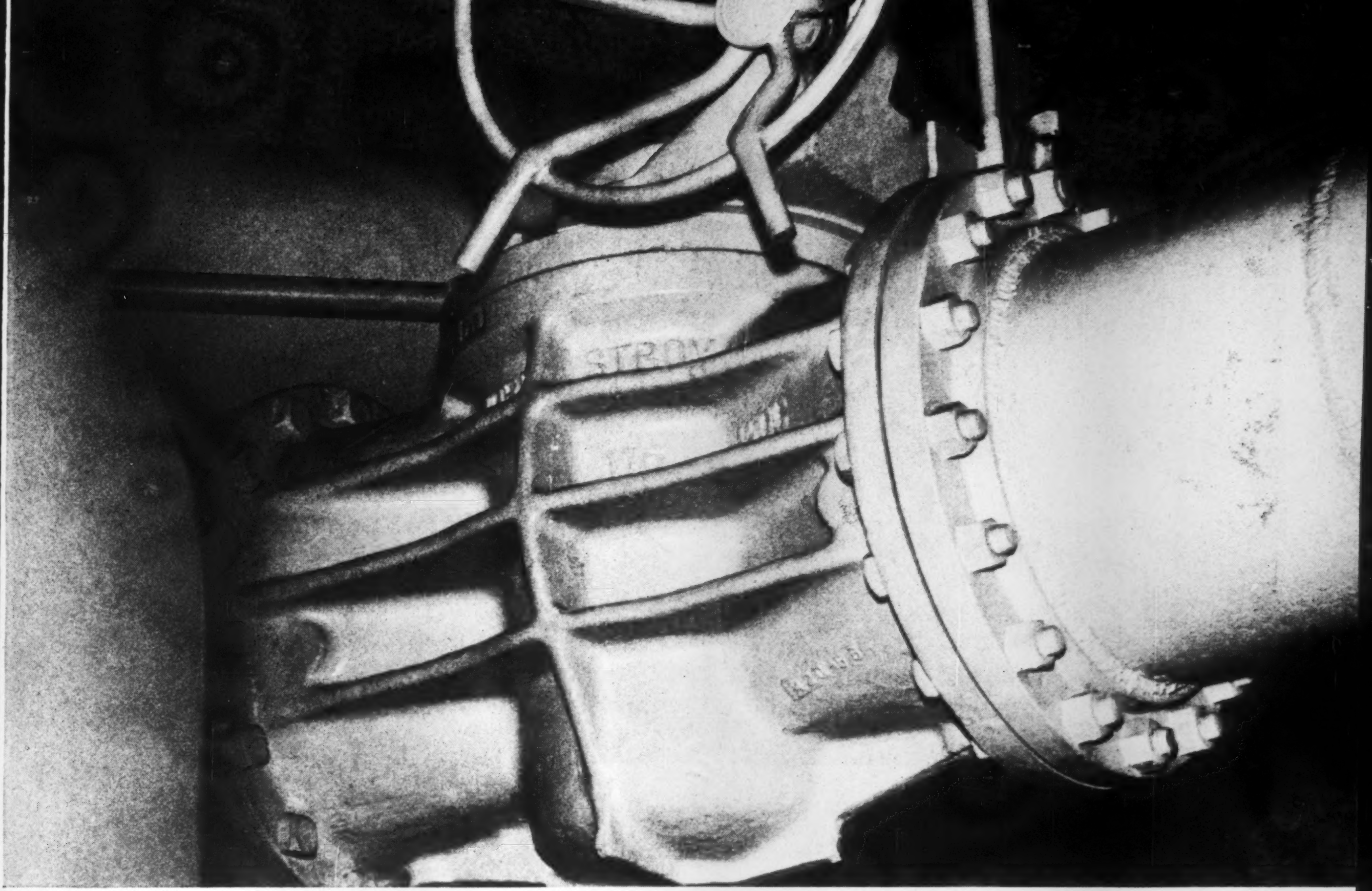
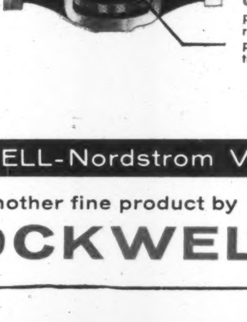


WHY is the trend toward

LUBRICATED PLUG VALVES

on chilled water lines?



SIZES TO 36": Lines above 8" are no longer a problem. Specify sizes and pressure rating to meet your design needs.

COMPACT: No bonnet cavity or rising stem saves weight and space.

PERFECT BALANCE: Plug is smoothly, easily positioned for precise throttling . . . wrench shows degree of throttle.

THROTTLE or SHUT-OFF: If desired, shut-off valve can be eliminated downstream from throttle valve. Positive shut-off assured by pressurized lubricant.

NO CHANCE OF CHATTER: Solid tapered plug is perfectly seated in rugged body . . . no exposed seats . . . silent for the life of the building.

More and more air conditioning engineers are specifying Rockwell-Nordstrom lubricated plug valves to insure that chilled water system performance will match design. These valves allow perfect system balancing . . . only a quarter-turn from full open to full close. The mated, tapered plug in the valve body prevents possibility of chattering. And since the Rockwell-Nordstrom valve is positively sealed against leakage by powerful hydraulic lubricant seals, it's often possible to eliminate the shut-off valve customarily used in front of the balancing valve . . . *one valve does the job of two.* For more of the advantages of these valves for heating, piping and air conditioning applications, see drawing at left. To get complete details, send the coupon. Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

another fine product by

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SEND FOR COMPLETE DETAILS TODAY

Rockwell Manufacturing Company, Pittsburgh 8, Pa.

☐ Please send Bulletin V-203 on valves for heating, piping and air conditioning installations.

☐ Please have your representative call.

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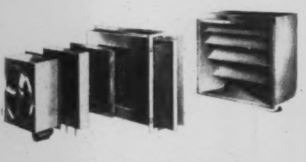
Comfort year 'round
in any climate with
Aerovent
Air Make-Up Units

Your best investment in modern air-handling equipment! New Aerovent Air Make-Up Units provide clean, fresh air in winter or summer; help maintain uniform temperature levels throughout working areas. Used as filtered-air supply units or air preheaters, these versatile units permit heating and ventilating systems to operate at design efficiency; equalize negative pressures by replacing exhaust air.

Steam, hot water or gas-fired models in sizes 18" to 54" (larger units available on order) for capacities, pressure conditions and BTU ratings to suit your requirements. Compact, packaged design for roof or wall mounting. Other assemblies also supplied for exclusive use in air supply or air heater applications. Why not investigate the many advantages of these high-efficiency units, today?



STEAM OR HOT WATER

Furnished in 7 unit arrangements in sizes 24" to 54". Capacities from 5,000 to 35,000 CFM. Roof or wall types for all requirements.

GAS-FIRED

Supplied in 4 unit arrangements for roof or wall mounting. Sizes 36" to 54" for various capacities, BTU ratings and pressure conditions.

Write for new Bulletin 880

Air deliveries of all Aerovent equipment are tested and rated in accordance with established and accepted codes and each unit is guaranteed by the manufacturer to deliver its rated performance.

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Aerovent FAN COMPANY, INC.
Ash and Branch Streets
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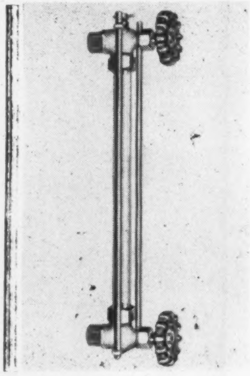
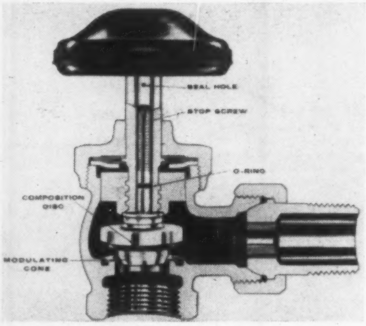
EQUIPMENT DEVELOPMENTS

Continued



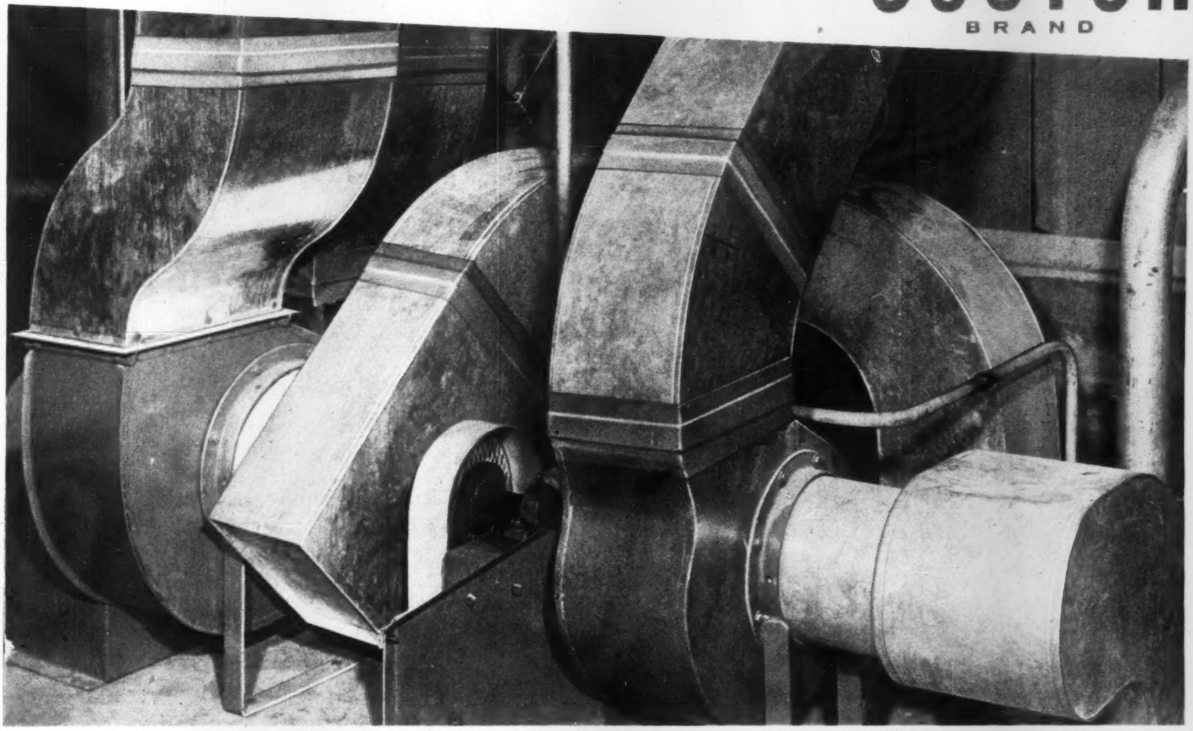
Water Gages . . .
. . . three bronze models, two in ½ in. sizes and one ¾ in.; 14 in. centers provided on ½ in. models, 18 in. centers on the ¾ in. unit; gages have small and efficient drain cock — *Crane Co., 155 N. Wacker Drive, Chicago 6, Ill.*

Plastic Pipe . . .
. . . high density polyethylene pipe for service in temperatures up to 150 F; resistant to chemicals; available in lengths up to 400 ft and in 75 and 100 psi working pressures — *Skyline Industries Sales, Inc., Titusville, Pa.*



Radiator Valves . . .
. . .packless units with adjustable orifice permits steam flow from 10 to 100 sq ft edr; on hot water, any flow at any pressure; available in ½, ¾, and 1 in. sizes; angle, straightway, and corner patterns; bulletin available on request — *Marsh Instrument Co., Div. of Colorado Oil and Gas Corp., Skokie, Ill.*

SCOTCH
BRAND



TAPEnology . . . industry's newest cost-cutting tool

TAPE EASES DUCT SEALING JOBS . . . TRIMS COSTS BY UP TO 50%, TOO!

Now you can seal and join ducts and insulating materials swiftly, safely, professionally with pressure-sensitive "SCOTCH" Brand Plastic Tape No. 474. Works perfectly on most heating, ventilating and air conditioning systems. Gives savings of up to 50% per installation.

Easy to apply—even in cramped working areas—metallic gray No. 474 Plastic Tape applies right from the roll. No special tools necessary. Provides a more efficient air-tight seal and conforms readily. Joins and seals all types of metal duct work (including high-velocity air systems) whether round, square or rectangular in shape. Forms flexible joints in minutes. Meets all flame resistant requirements as set forth in National Fire Protection Association's standard 710. Provides superior mechanical strength—duct work can be actually smashed without affecting the seal.

"SCOTCH" Plastic Tape No. 474 is available in various widths on 36 yard rolls. Call your "SCOTCH" Brand Tape Distributor, or write: 3M Co., 900 Bush Ave., St. Paul 6, Minn., Dept. IAT-100.

When tape costs so little, why take less than "SCOTCH" *Brand?*

"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL 6, MINN.
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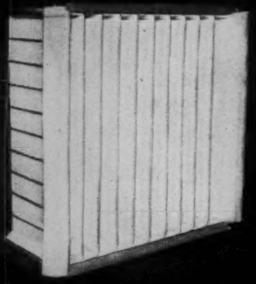
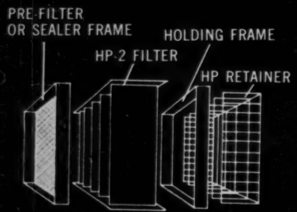
Combining efficiency and lowest cost/CFM, Farr HP-2 Disposable Filters protect this and many other great buildings. ● The exclusive folding design of the Farr HP's yield a large filtering area in a compact filter cell. Ten HP-2's fold into the same size carton that contains only one ordinary pleated-type filter, permitting instant box-to-filter bank installation, compact storage, easy disposal. ● Farr HP Series Disposable Filters give positive, constant performance. The HP-100 and HP-200 are available for higher efficiency requirements.





For further information write to:

FARR COMPANY
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Architects:
Naess & Murphy
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General—G. A. Fuller Co.
Ventilating and Air Conditioning—
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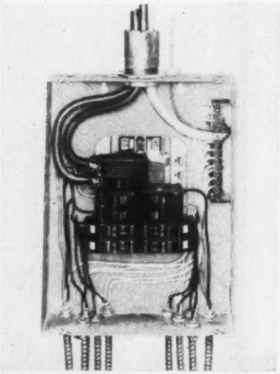


Circuit Breakers . . .

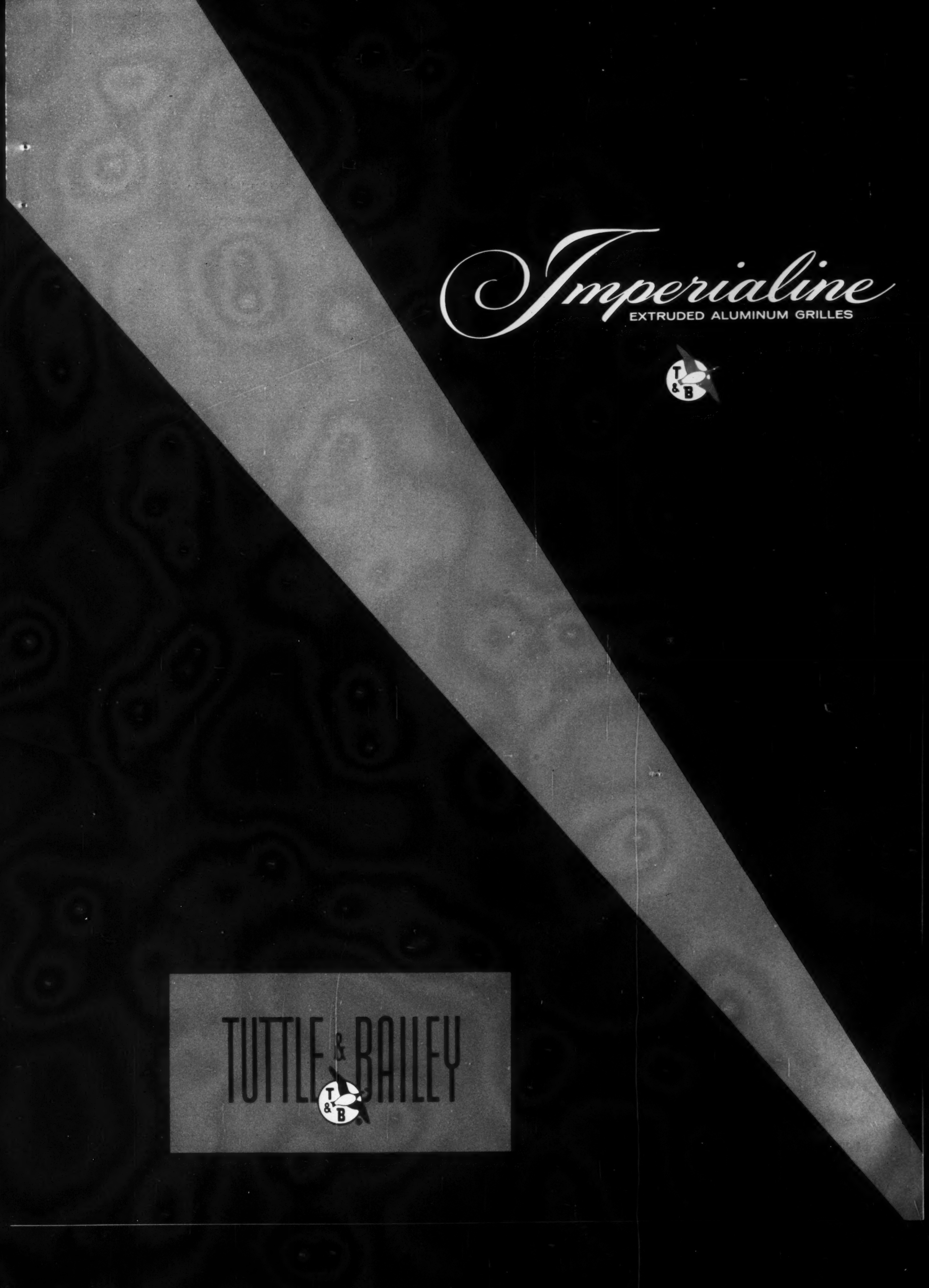
. . . plug-in type, 70 and 100 amp, 2 pole, rated at 120/240 v a-c, for use as either main or branch circuit disconnect; feature silver plated current carrying parts and recessed self aligning spring-reinforced bus receptacles; bulletin "GEA-7071" available on request—*General Electric Co., Distribution Unit, Plainville, Conn.*

Corrosion Protective . . .

. . . one-part powdered 100 percent epoxy resin gives physical and electrical protection; completely thermoset and has adhesion strength of more than 3000 psi, high impact resistance; resists most chemicals including hydrocarbons — *Minnesota Mining and Mfg. Co., 900 Bush Ave., St. Paul 6, Minn.*

Foot Valves . . .

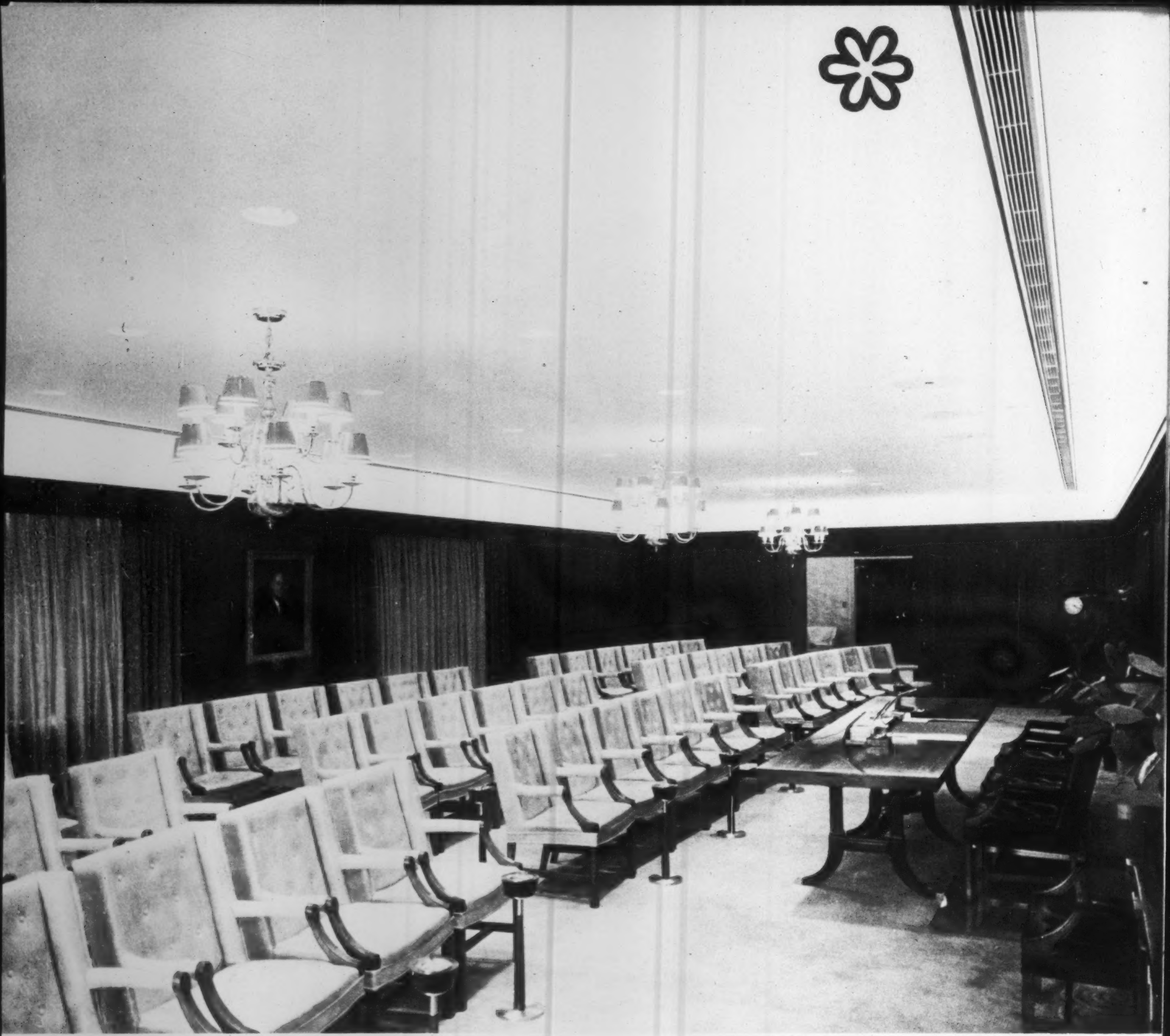
. . . designed for working pressure ratings of 200 psi cold water, non-shock; size range of ½ to 3 in.; unit has one-piece valve body with integral seat — *Crane Co., 155 N. Wacker Drive, Chicago 6, Ill.*



Imperialine

EXTRUDED ALUMINUM GRILLES

TUTTLE & BAILEY



Imperialine

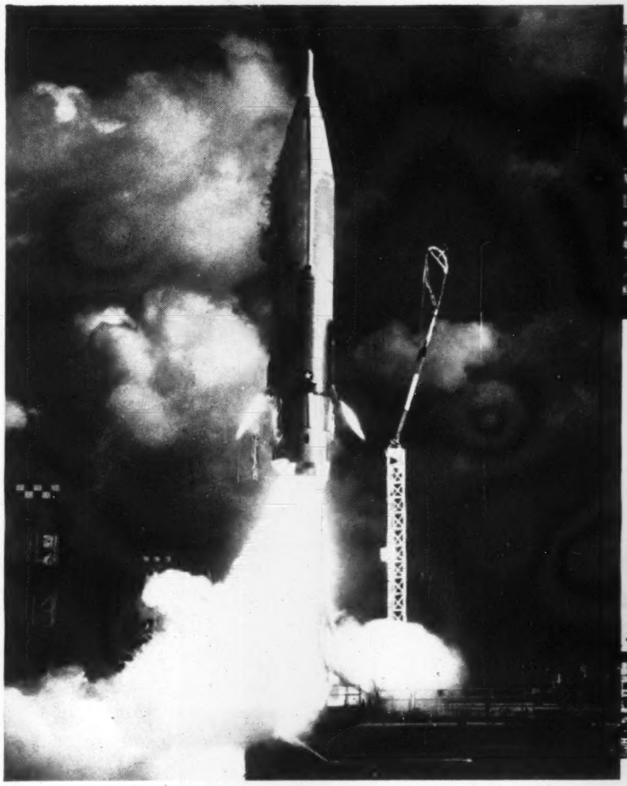
EXTRUDED ALUMINUM GRILLES

Featuring trim, attractive, straight-line styling, Tuttle & Bailey Imperialine EXTRUDED ALUMINUM GRILLES are the answer to architectural demands for air distribution equipment that will harmonize with, or accent, linear design concepts. Universal in application, Imperialine Grilles may be used on the supply or return portions of heating, cooling, or ventilating systems and are ideal for ceiling, sidewall, floor, or sill installation. A Tuttle & Bailey exclusive, the grilles are standard with satin anodized finish. Special finishes and colors are also available.

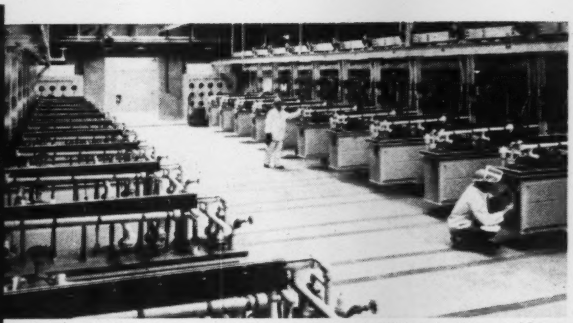
For complete catalog data on Imperialine Extruded Aluminum Grilles, ask your nearest T&B Representative or write direct.

TUTTLE & BAILEY
division of Allied Thermal Corp.
New Britain, Connecticut

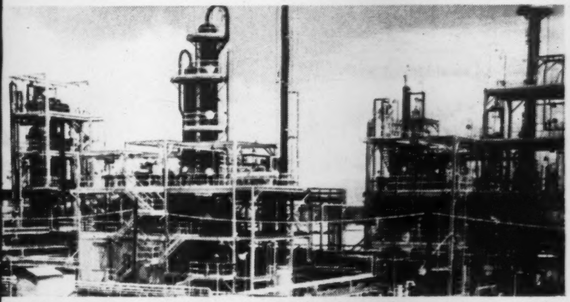
TUTTLE & BAILEY PACIFIC, INC. City of Industry, California



Providing tremendous thrust, new rocket fuel oxidizers such as liquid fluorine, chlorine trifluoride and other halogen fluorides may help us conquer space. Like "Genetron" fluorinated hydrocarbon refrigerants, they are important developments of General's long research in fluorine chemistry.



Largest privately-owned fluorine producing facilities in the world are located at General Chemical's Metropolis, Ill., Works. In these cells elemental fluorine is produced for use as a high-energy oxidizer of rocket fuels and for production of uranium hexafluoride for the Atomic Energy Commission. Allied Chemical's leadership in fluorine chemistry is applied to continuing improvement of "Genetron" refrigerants.



This giant fluorochemical center in Baton Rouge, La., makes many of the fluorine-based compounds required by industry and is a major production center for "Genetron" refrigerants. "Genetron" refrigerants are also manufactured in Danville, Illinois. Soon a new plant in Elizabeth, N. J., will provide a large new source for "Genetron" refrigerants.

What do rockets have to do with genetron® super-dry refrigerants?

Just this. Part of the "big push" into outer space may come from fluorine-based propellants now being supplied by General Chemical to the nation's rocket and missile research centers. The same know-how that makes General Chemical the leader in fluorine chemistry applies equally in other areas—especially in the development and production of "Genetron" fluorinated hydrocarbon refrigerants.

Behind "Genetron" Super-Dry Refrigerants is a research organization which is internationally recognized for its work in fluorine chemistry. Even more important to every user of "Genetron" refrigerants are the Company's advanced manufacturing facilities, which have helped bring quality standards for fluorinated hydrocarbon refrigerants to new highs of purity and dryness—a major contribution in itself.

"Genetron" Refrigerants are approved, accepted, *preferred* because they are *performance-proved.* Refrigeration engineers, contractors and servicemen endorse them. Wholesalers recommend them.

It makes sense to rely on the leader in fluorine chemistry for fluorinated hydrocarbon refrigerants. Next time you order, insist on "Genetron" and be sure of the best! Available from wholesalers everywhere.

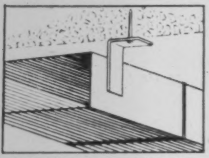
Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

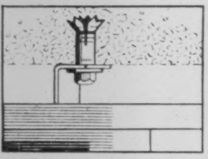
Look to the leader in fluorine chemistry... insist on "Genetron."

THE NELSON LINE
A fastener for *every* construction or maintenance job!

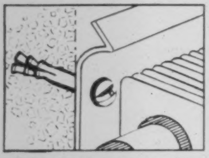
TYPICAL APPLICATIONS



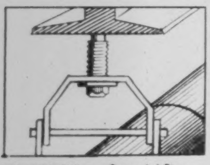
Drivestuds—Suspended Duct



Drill/Anchor—Suspended Heater



Drive/Anchor-Convection Heater



Stud Welding—Suspended Pipe

NELSON DRIVESTUDS—For powder-actuated fastening of wood or metal to concrete or steel. No drilling, no chipping ...more fastenings per hour with the NELSON Stud Driver.

NELSON BULLDOG DRILL/ANCHORS—No special drills to buy...eliminates time-consuming drilling and use of old-fashioned anchors. Save on labor—save on material costs.

NELSON BLUE-CHIP DRIVE/ANCHORS—All-steel ¼" combination bolt and anchor. Fast installation, low-cost fastening. Can be used in masonry, brick, and wood.

NELSON STUD WELDING—Split-second end-welding to steel and aluminum. Eliminates costly clamps, drilling and through-bolting.

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WAREHOUSES COAST-TO-COAST

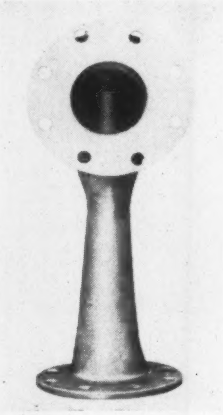
GREGORY INDUSTRIES, INC., 102-10 Toledo Avenue, Lorain, Ohio
Please send details about:

☐ NELSON® STUD DRIVERS
☐ NELSON BULLDOG Drill/Anchor
☐ NELSON Blue Chip DRIVE/ANCHORS
☐ NELSON® STUD WELDING

NAME ____ TITLE ____
COMPANY ____
ADDRESS ____
CITY ____ ZONE ____ STATE ____

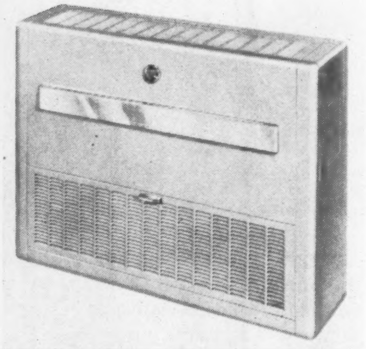
EQUIPMENT DEVELOPMENTS

Continued



Gas Scrubbers . . .

. . .designed to move large quantities of air and gas at low draft; fiberglass construction makes units resistant to most acids and other nonoxidizing materials; removes dust and particulate matter, vapors, and corrosive gases; low weight units can be used in existing piping without elaborate supporting steel — *du Verre Inc., P.O. Box 37, Arcade, N.Y.*



Air Conditioners . . .

. . . self-contained, through-the-wall room units utilize hermetically-sealed refrigerant cycle combined with heating coils for connection to hot water or steam systems; models with electric heating element also available; cooling capacities range from 9000 to 12,000 Btu per hr; heating capacities from 14,900 to 24,400 Btu per hr; bulletin 760-B available on request — *Modine Mfg. Co., 1509 De Koven Ave., Racine, Wis.*

Allied forms new

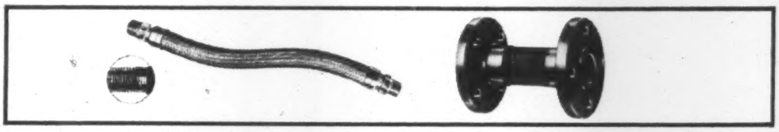
Heating, Airconditioning, & Piping Division to serve specifiers, installers, & users of Flexible Pipe Connectors

OFFERS COMPLETE ALLFLEX SERVICE FOR CONTROLLING PIPELINE MOTION IN HEATING, COOLING, & PLUMBING SYSTEMS

Immediate, experienced, on-the-spot service in solving pipeline problems caused by vibration, thermal expansion, and misalignment is now offered by Allied Metal Hose Company's new "H.A.P." Division, the latest specialized unit created under the firm's continuing expansion program.

The new division will serve Mechanical Engineers and Contractors thru a nationwide network of factory trained pipe-motion-engineering sales specialists, according to an announcement by Fredric R. Cahn, the company's Director of Sales.

Backed by ALLIED's extensive engineering and custom-fabrication facilities — these specialists are now at the disposal of heating, cooling, and plumbing engineers, contractors, distributors and jobbers who design, specify, furnish, or install piping for pumps, compressors, turbines, condensers, cooling towers, radiators, or other fluid or air handling machinery in commercial and industrial building.



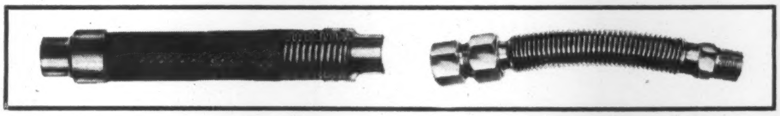
Typical H.A.P. Flexible Pipe Connectors include:

A) H.A.P. FLEXible PIPE-to-pump Connectors,
B) H.A.P. FLEXible COMPressor-to-pipe Connectors,
C) ALLFLEX VIBRATAMERS

Installed at suction and discharge ports of pumps and compressors to absorb, attenuate and isolate vibration, preventing its full transmission to the pipeline; absorb & compensate for dimensional changes caused by temperature induced pipeline contraction & expansion; and to take up slight pipeline misalignment. H.A.P. connectors minimize unbalance and excessive wear, insuring longer pump and compressor service life, and reducing maintenance time and cost.

These connectors consist of a corrugated and braided flexible tube, with Threaded, Flanged, Tube or Pipe ends. Furnished in all standard sizes — thru 16 in. in Stainless Steel, 8 in. in Bronze & Hot-dip-galvanized Steel, and 4 in. in Monel (an ALLIED "first").

D) H.A.P. Expansion Compensators, Absorb and take up pipeline expansion at right angles to the direction of movement. Designed to meet specified working conditions, these expansion compensators come in a wide variety of constructions (including unbraided for low pressures).



For complete information, experienced assistance, and the name of the Allied HAP Division Representative in your area, Write, Wire or Phone

ALLIED METAL HOSE COMPANY, Long Island City 1, N.Y., STillwell 4-5173

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write, wire, phone today for "VIBRATAMER" DATALOG 601

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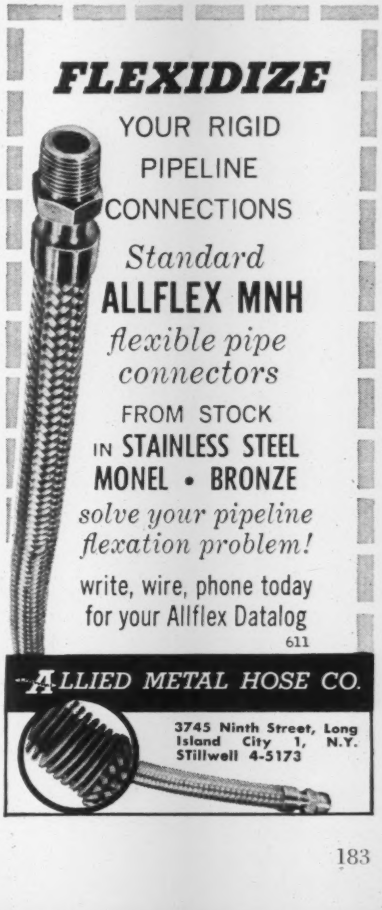

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Standard

ALLFLEX MNH

flexible pipe connectors

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solve your pipeline flexation problem!

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Satisfy Every Control Need . . . with this complete line that includes: Standard, Mushroom, Extended, Metal and Lock-Type Buttons; Pilot Lights; Standard and Lock-Type 2- and 3-Position Selector Switches; and variations, modifications and accessories to meet individual needs.

Meet Highest Performance Standards . . . push button and pilot devices all interchangeably mounted, are sturdily constructed from quality materials and deliver long life and dependable operation on the toughest, heavy-duty industrial applications.

Write today for complete information on these A-H Oil Tight Push Buttons . . . and also on our standard Duty and Heavy Duty Push Button Lines. The Arrow-Hart & Hegeman Electric Company, Dept. HPAC, 103 Hawthorn St., Hartford 6, Conn.

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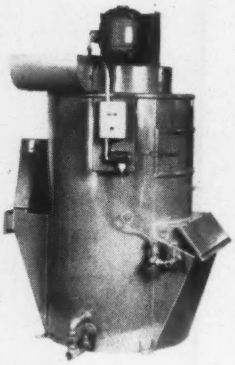
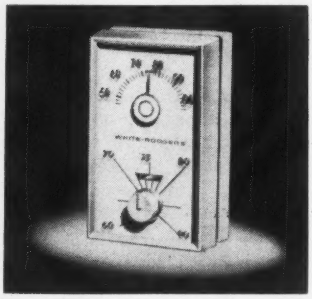


Dust Collector . . .

. . . wet type unit with no moving parts; adaptable to metal grinding, finishing operations, and other uses; unit will remove dirt, dust, grindings, chips, fumes, and vapors; requires little floor space — *The DeVilbiss Co., 300 Phillips Ave., Toledo 1, O.*

Edge-Scriber . . .

. . . for marking lines on sheet metal at a predetermined distance from edge; made of 16 gage, plated steel; calibrated in dimensions of $\frac{1}{8}$, 3/16, $\frac{1}{4}$, 5/16, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, and $\frac{3}{4}$ in. — *Duro Dyne Corp., Route 110, Farmingdale, N.Y.*



Thermostat . . .

. . . vertically styled unit with plastic base and snap-on cover; sealed mercury contacts protect against dirt, dust, and corrosion; fixed heat achieved through removable carbon disk resistors; measures 4-$\frac{1}{2}$ in. high × 2-$\frac{3}{4}$ in. wide × 1-$\frac{1}{2}$ in. deep; folder "R-1691" available on request — *White-Rodgers Co., 1209 Cass Ave., St. Louis 6, Mo.*

BONUS LIFE
BONUS PROTECTION

from the Boiler Capital of the World

THE
TITUSVILLE
WTP
FROM THE BOILER CAPITAL OF THE WORLD

- BONUS LIFE means longer life and less refractory maintenance made possible by Titusville's unique WTP design featuring *65% Black Surface Tube Area coverage on rear wall.*

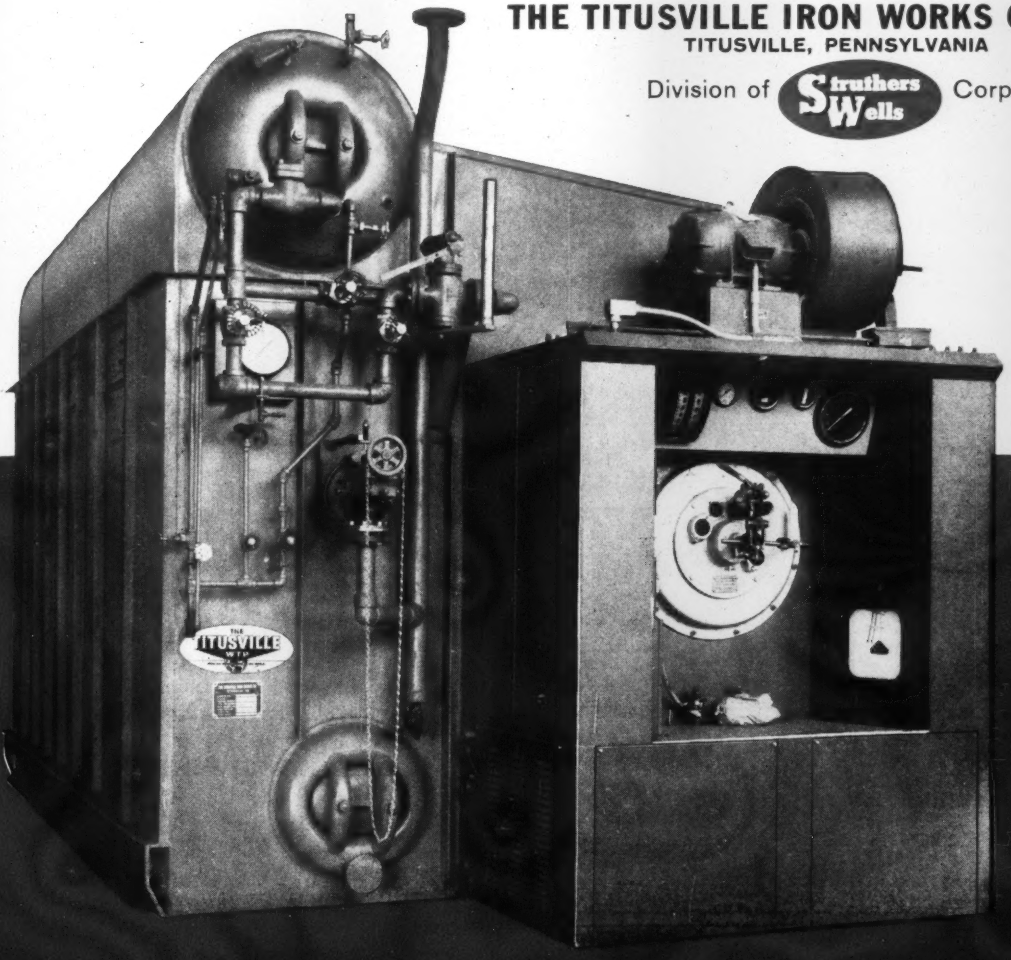
Titusville's increased black surface tube area means less refractory maintenance through longer refractory life (less down-time for replacement) and a faster steamer.

- BONUS PROTECTION provided by Titusville WPT's *double casing design* solves the corrosive product problem.

Most water tube steam generators operate intermittently. When dew point is approached at low fire condition, corrosive product can form quickly in single casing boilers.

Titusville WTP's double casing design (with insulation between) reduces temperature differential. Result: formation of corrosive product almost entirely eliminated for many times more casing life.

THE TITUSVILLE IRON WORKS COMPANY
TITUSVILLE, PENNSYLVANIA
Division of Struthers Wells Corporation



For your BONUS LIFE and BONUS PROTECTION specify WTP from Titusville

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Now available at lower prices...

Proven METTLER Junior "Fan-Air" Gas Burners in capacities from 100,000 to 3,600,000 btu/hr

For low-cost, safe, efficient conversions, here are packaged burners you can't beat! Mettler's proven "Fan-Air" Burner efficiency is designed into compact, easily installed, fully automatic Junior units to permit lowest cost conversion of boilers, furnaces, and process heating equipment.

Multiple gas jets properly atomize fuel and mix with unrestricted air supply, provide clean, noiseless combustion — *and* fuel economy. Safe? You bet! Patented Mettler spark-ignited rectifier safety pilot and dependable electronic flame safety relay stand constant watch on flame failure.

Want full details? Before you specify or buy any burner, write us for your free copy of Bulletin G-100-B. Or contact your Mettler representative for complete information.

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Eclipse

THE METTLER CO., INC.
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1101 Buchanan St., Rockford, Illinois

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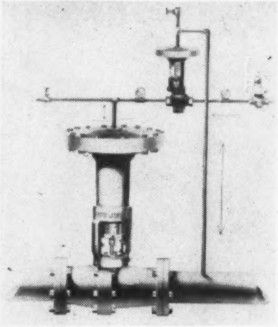
Temperature Cutout . . .

. . . unit combines temperature cutout feature with continuous temperature indication; available in two models: model "N-30" will not shut off upon line voltage failure; model "N-34" will shut off in such a condition; can be used to sound an alarm; available in 11 ranges from 0-400 F to 0-3000 F, as well as an environmental test chamber range of −100 to −300 F —*Alnor Instrument Co., Div. of Illinois Testing Laboratories, Inc.*, 418 *N. LaSalle St., Chicago* 10, *Ill.*

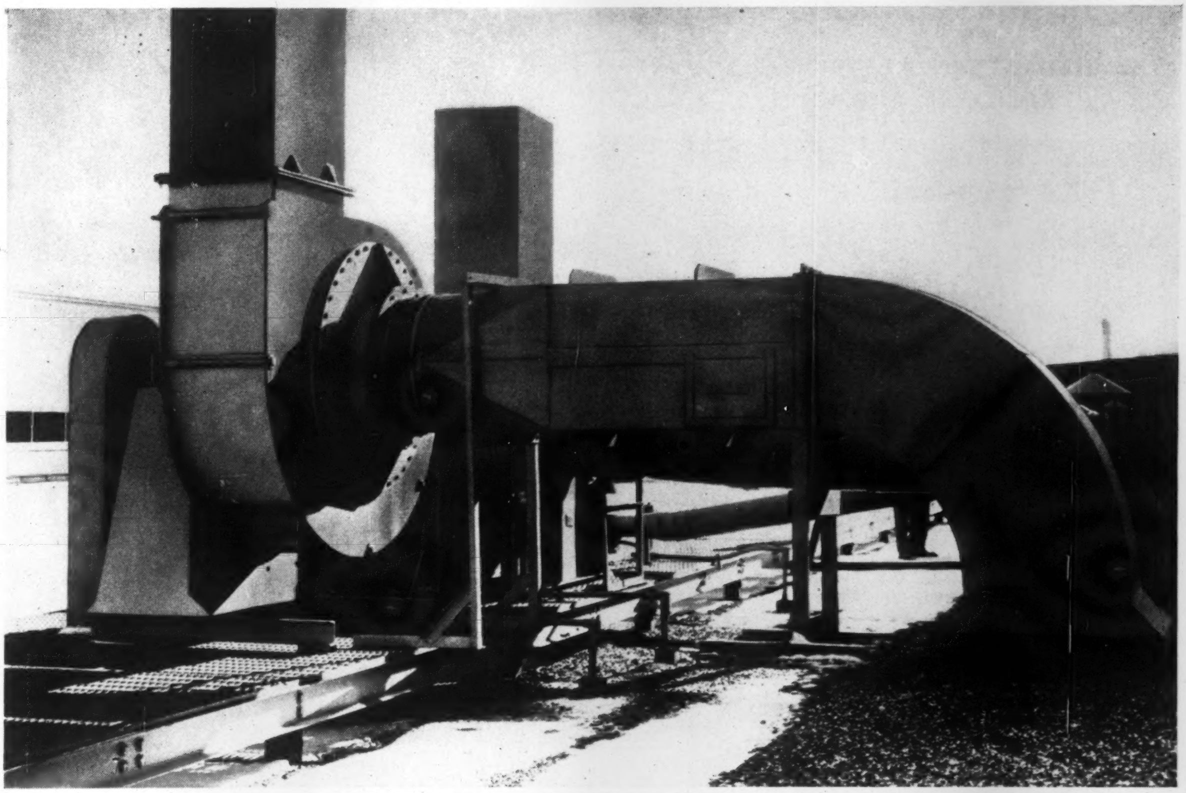


Reducing Valves . . .

. . . feature capacity of 50,000 lb of steam per hr or 2500 gpm of water; available in 4 and 6 in. sizes, system suitable for pressures to 250 psi and temperatures to 500 F; main valve available in ductile iron and cast iron, flanged, features sliding gate and plate seats; bulletin "SRBe 16-60" available on request — *OPW-Jordan*, 6013 *Wiehe Rd., Cincinnati* 13, *O.*

Another new development using

B.F.Goodrich Chemical *raw materials*



Blowers and fans, ductwork and fittings and bolts, nuts and washers are all manufactured of Geon by Industrial Plastic Fabricators, Inc., Norwood, Mass. B. F. Goodrich Chemical Company supplies the Geon polyvinyl material.

Blower and ductwork of Geon solve corrosive fume problems

The manufacturer of this air handling equipment can promise buyers efficiency as high after years of operation as right now. The equipment is made from sheet made of Geon rigid vinyl. Unlike conventional coated blowers and fans which usually handle just one type of chemical fume, this equipment withstands corrosion and residual build-up of nearly all chemicals. Installations are often lower in cost because of weight savings.

Sheet of Geon rigid vinyl is extremely versatile for fabrications like this—it can be heat-formed to a variety of shapes, precision welded, machined and finished to close tolerance. The flexibility made possible with Geon makes possible new design features impractical with other materials because of prohibitive costs.

Geon rigid vinyl materials are providing new applications and new markets for a broad variety of manufacturing companies. For information about the many forms in which Geon can be obtained, write Dept. GG-5, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

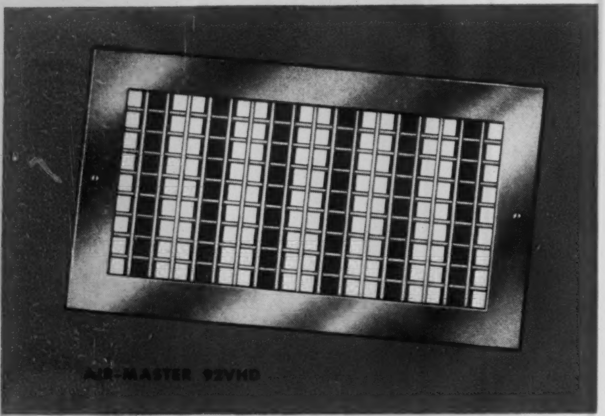
A TRADE MARK OF B.F.GOODRICH CHEMICAL COMPANY
Geon
VINYLS
A DIVISION OF THE B.F.GOODRICH COMPANY

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich GEON vinyls • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers

Announcing the New
Air-Master Series 92

THE ULTIMATE IN ADJUSTABLE LOUVRE
REGISTERS AND GRILLES



Here's 4-way deflection with "pin-point" air control . . . for commercial and residential installations . . . the product of years of testing and development.

- CONSTRUCTED OF RUST-FREE
ALUMINUM
- COMPLETELY CONDENSATION-PROOF

A sturdy, yet lightweight unit that defies comparison for both beauty and performance.

The Air-Master series contains four register styles and four styles of grilles. All standard and non-standard sizes are now available.

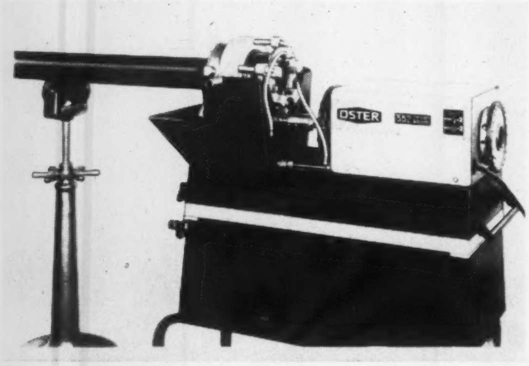
Ask your local jobber about the new Air-Master Series and get your copy of the new full-color A & A Catalog 60 or write direct to:

A & A

THE A & A REGISTER COMPANY
The complete line of Registers · Diffusers · Grilles
5327 CLINTON ROAD • CLEVELAND 9, OHIO
ATlantic 1-6166

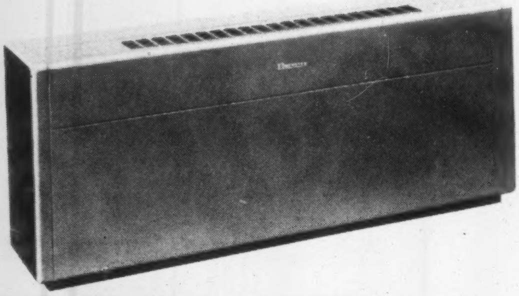
EQUIPMENT DEVELOPMENTS

Continued



Pipe Threader . . .

. . .geared die-stock adaptation for threading up to 4 in. pipe; designed for use with firm's model No. "552," but can be adapted to any of firm's 2 in. machines; tool is held stationary while pipe revolves as thread is cut — *The Oster Mfg. Co.,* 1340 *E.* 289*th St., Wickliffe, O.*

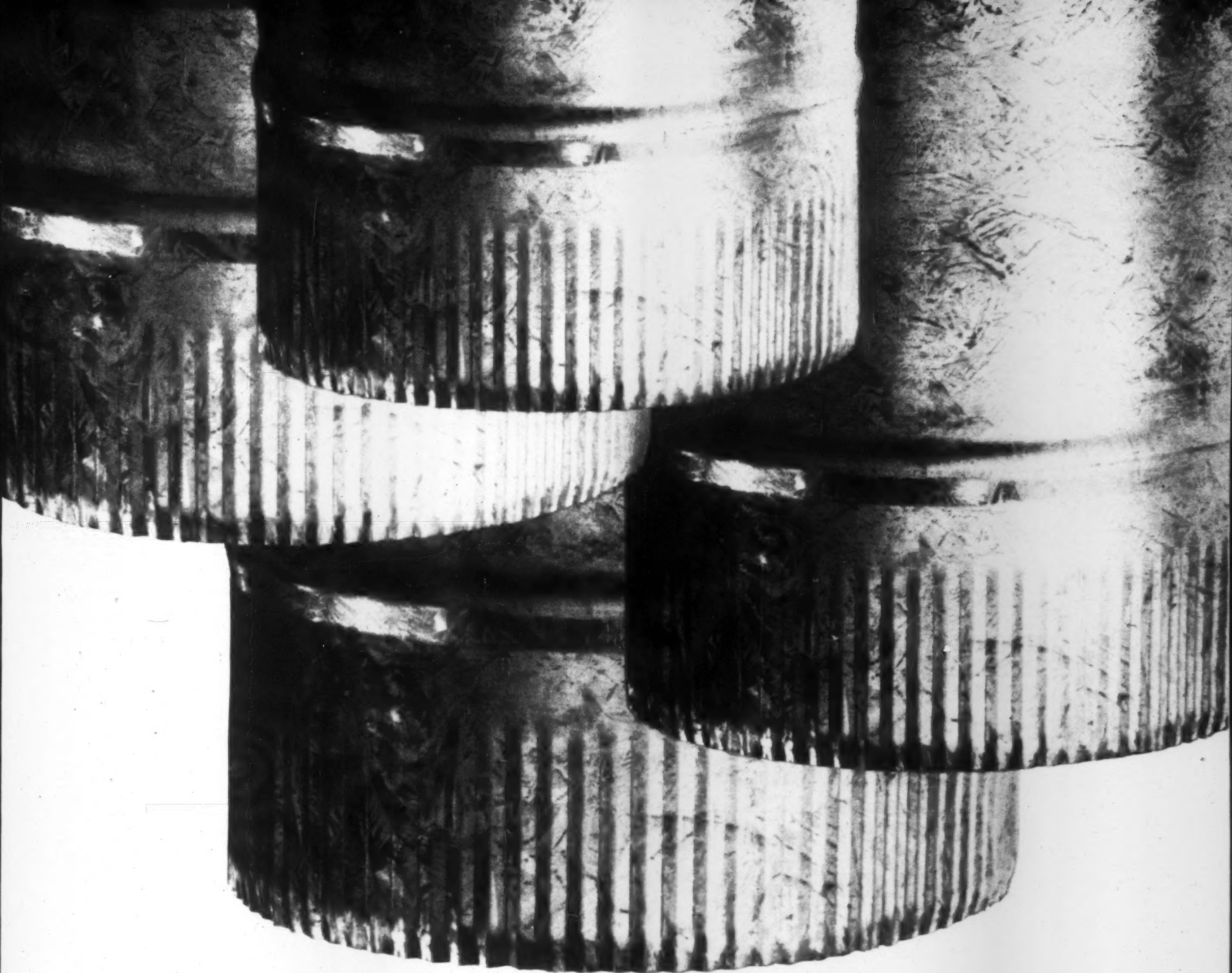


Fan-Coil Unit . . .

. . . designed for perimeter installations in schools and similar structures; offered in range of sizes from 500 to 1600 cfm; engineered for use in conjunction with firm's line of perimeter wall-type convector units — *Warren Webster & Co., Inc.,* 1664 *Federal St., Camden* 5, *N.J.*

Pressure Control . . .

. . . designed to control electic motor and alarm circuits in sprinkler systems; may be used with alarm check, dry pipe, and special water control valves; adjustable from 0 to 20 psi with range stop at 20 psi; proof pressure 300 psi, maximum pressure, 500 psi; single pole switches suitable for ambient temperatures up to 180 F; standard electrical rating, 15 amp, 120/240 v, a-c; other ratings available — *United Electric Controls Co., 79A School St., Watertown 72, Mass.*



The more crimping you have to do, the more satisfied you will be with Weirkote Zinc-Coated Steel. There's no peeling, no chipping, no flaking. Work it to the limits of the steel base itself and the zinc coating remains intact assuring you of the complete corrosion protection that only zinc can give. Weirkote is made that way—to retain its protective zinc coating no matter how tough the forming and bending operations. A Weirton representative will gladly supply full information on Weirkote—another fine product of the Weirton Steel Company, Weirton, West Virginia.

Galvanized Steel

Look for the STEELMARK on the products you buy; place it on the products you sell.

WEIRTON STEEL

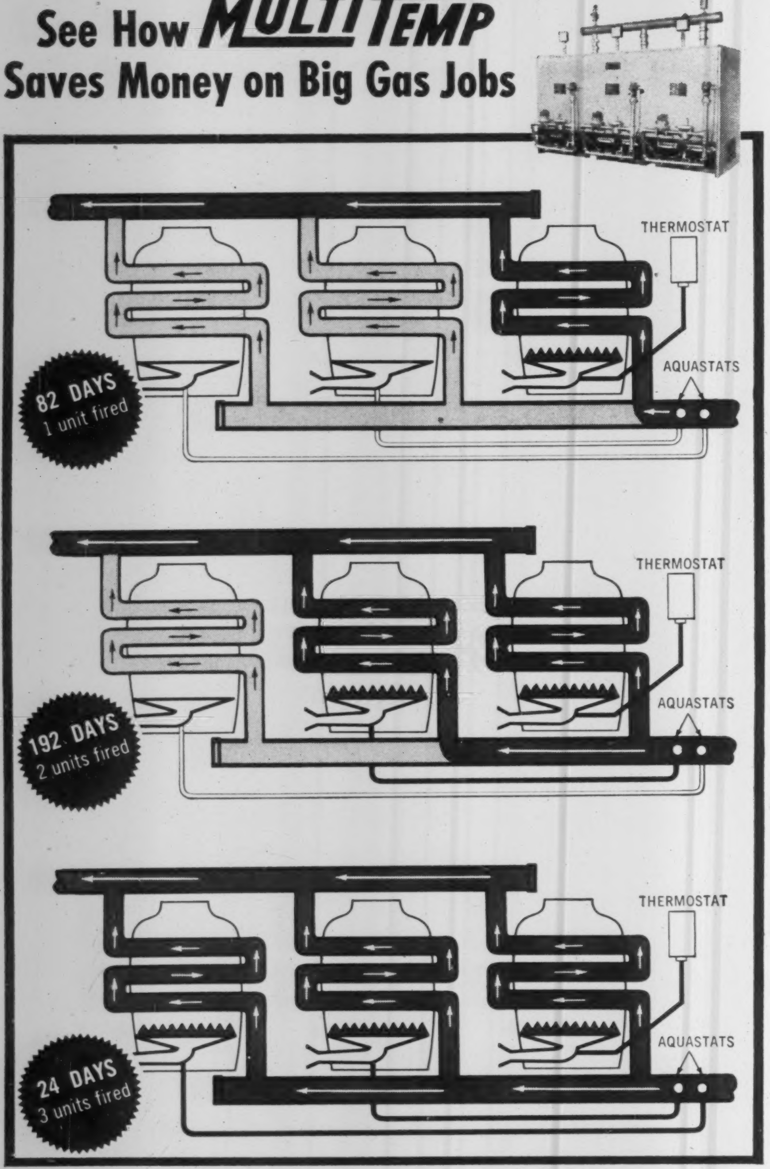
Weirton, West Virginia

WEIRTON STEEL COMPANY

Weirton Steel is a division of **NATIONAL STEEL CORPORATION**

Weirkote will also be available in 1961 from National's Midwest Steel Division, Portage, Indiana.

See How MULTITEMP Saves Money on Big Gas Jobs



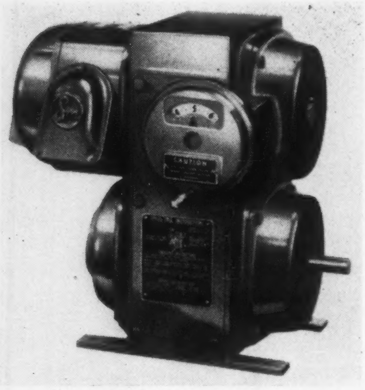
CUTS SHORT CYCLING, FUEL WASTE, INSTALLATION COSTS

Diagram shows how cast iron MULTI-TEMP Hot Water Heating Plants automatically adjust capacity to load — save fuel dollars! Sensing elements in return water header call in additional combustion units, one-by-one, as temperatures drop. The load distribution shown is typical of our northeastern region. Note: full capacity was required during only 3% of heating season, and a single unit could meet demand for over 25% of season. Set-up time is saved too — batteries do not require field rigging or joining of sections — come factory assembled with controls. Maintenance is easy on individual units without service interruptions. Capacities up to 3,600,000 BTU/hr., rated at 100# ASME working pressure. For space heating and volume water heating. *Write for catalog HY-F107 today!*

HYDROTHERM INC

DEPT. 13-AC, NORTHVALE, NEW JERSEY

FIRST IN HYDRONIC GAS HEAT



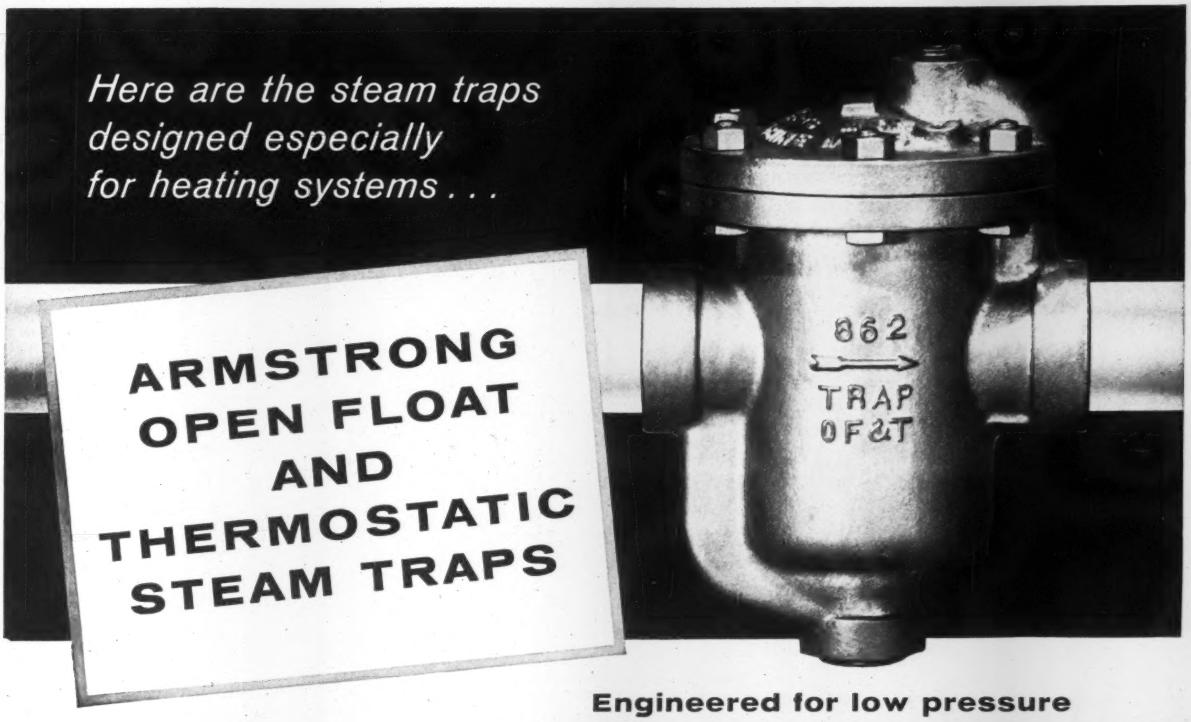
Variable Speed Drive . . .

. . . speed ranges from 4660 to 1.2 rpm with up to 10 to 1 variation; offered in 1/4, 1/2, and 3/4 hp ratings; NEMA standard dimensions for shaft height and diameter permit substitution with standard motors; may be foot mounted in any position or is furnished with face mounting bracket; available with right angle and helical gears; bulletin "201" available on request — *Sterling Electric Motors, Inc.*, 5401 *Telegraph Rd., Los Angeles* 22, *Calif.*

Portable Heaters . . .

. . . oil furnace on wheels blows air around outside of completely enclosed combustion chamber to insure clean air; any fumes can be vented out top; model "S200 ID" produces 200,000 Btu per hr at 1600 cfm; model "S420" produces 420,000 Btu per hr at 4500 cfm — *Stow Mfg. Co.*, 350 *Shear St., Binghamton, N.Y.*

Here are the steam traps designed especially for heating systems . . .



ARMSTRONG OPEN FLOAT AND THERMOSTATIC STEAM TRAPS

Engineered for low pressure intermittent service where large amounts of air accumulate while steam is off

Armstrong O.F.&T. Traps make it possible for heating systems to deliver the efficiency they were designed to deliver. They are ideal for low pressure unit heaters, preheat and reheat coils, converters, hot water generators, etc.

Advantages to the user:

BIG AIR HANDLING CAPACITY—Thermic vent handles large amounts of air in system when steam is turned on. Fixed vent handles normal air in system.

NO STEAM LOSS—Stainless steel valve is water sealed, is not damaged by dirt or scale, cannot develop steam leaks.

CONDENSATE AND AIR REMOVED AT STEAM TEMPERATURE—No opening lag.

LONG LIFE—All working parts, including open float, are stainless steel. Bodies and caps designed for 250 psig operation. Open float cannot collapse.

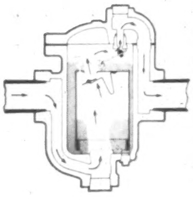
MINIMUM MAINTENANCE—Simple, proved design and high quality materials assure trouble-free service.

LOW COST—Mass production methods permit high quality at low cost.

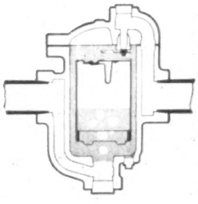
EASY INSTALLATION—Horizontal straight-through pipe connections, conventional sizes.

UNCONDITIONALLY GUARANTEED—All Armstrong Traps are guaranteed to satisfy the user or purchase price will be refunded.

HOW ARMSTRONG O. F. & T. TRAPS WORK:



When steam is turned on, it pushes air through the wide open thermic vent and trap discharge valve at full differential pressure between supply and return lines. Condensate formed by incoming steam goes right through.



As steam reaches open float, thermostatic vent closes. Float fills with steam and rises to close trap valve. Residual air and CO_2 escape through fixed vent at steam temperature.

BULLETIN NO. 775

BULLETIN NO. 801

Use the coupon at right to get these helpful bulletins: No. 775 describes O.F.&T. traps fully. No. 801 tells how to select traps for draining unit heaters including data on 30 makes of unit heaters.

ARMSTRONG MACHINE WORKS
8746 Maple St. • Three Rivers, Mich.

Armstrong Machine Works
8746 Maple St., Three Rivers, Mich.

Please send me: ☐ O.F.&T. Trap Bulletin No. 775; ☐ Unit Heater Bulletin No. 801.

Name..

Company..

Address..

City..Zone......State........................

which size stack do YOU prefer?

Each does the same job— the smaller one is equipped with a Lehigh Induced Draft Fan

Lehigh Induced Draft Fans are designed to help eliminate large, costly, unsightly stacks. They maintain a *constant* over-fire draft regardless of atmospheric conditions, help keep boilers operating at *maximum* efficiently at all times, and significantly *lower fuel bills* . . . while radically *reducing* the size of your stack.

Rugged Construction—long life: to prevent distortion under elevated temperature conditions, the fan housing, bearing pedestal, motor support and fan wheel of Lehigh Draft Induced Fans are constructed of all-welded integral 3/16″ mild steel. A radiant heat cover and an aluminum heat flinger protect the inboard bearing from radiated heat. And because both bearing and shaft are kept to a low operating temperature, the Lehigh Induced Draft Fan makes use of standard, self-aligning ball bearing pillow blocks. *All* Lehigh Induced Draft Fans feature a flanged inlet, flanged outlet, and inspection cover as standard equipment.

If you would like to reduce stack height . . . and gain optimum boiler efficiency . . . contact your local Lehigh Representative today. He'll gladly give you all the details. Or write directly to us for our detailed technical bulletin:

2171
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LEHIGH FAN & BLOWER DIVISION
FULLER COMPANY, CATASAUQUA 1, PA.
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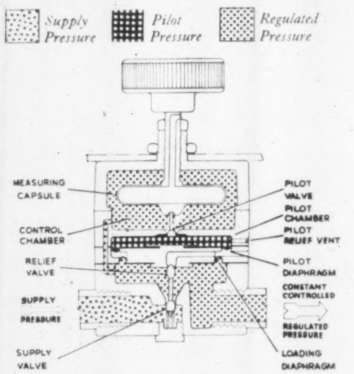
LEHIGH

EQUIPMENT DEVELOPMENTS

Continued


Supply Pressure
Pilot Pressure
Regulated Pressure
MEASURING CAPSULE
CONTROL CHAMBER
RELIEF VALVE
SUPPLY PRESSURE
SUPPLY VALVE
PILOT VALVE
PILOT CHAMBER
PILOT RELIEF VENT
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CONSTANT CONTROLLED
REGULATED PRESSURE
LOADING DIAPHRAGM

Air Pressure Regulator . . .

. . . for precise control of air or gas pressure; holds pressure to 1/50 of 1 percent of its range over substantial variations in supply pressure, flow, and ambient temperature; accuracy is one part in 10,000 of range; unit uses regulated pressure for pilot energy; available in 2-25, 3-60, or 3-120 psi ranges for 1/8 in., 1/4 in. or 3/8 in. NPT pipe — *Lexington Controls, Inc., P.O. Box 132-J, Burlington, Mass.*

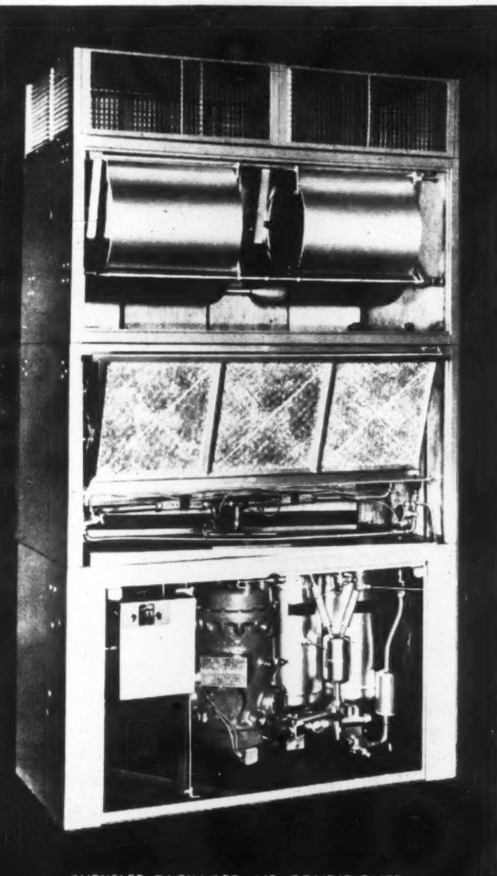
Swedging Tool . . .

. . . designed to expand six different tubing sizes to facilitate joining two separate tubes of the same size; tool will expand 3/16 in., 1/4 in., 5/16 in., 3/8 in., 1/2 in. and 5/8 in. tubing — *Robinair Mfg. Corp., Montpelier, O.*

WOLVERINE TUBE HELPS

CHRYSLER

"CREATE CLIMATE FOR LIVING WHEN NATURE DOESN'T"



CHRYSLER PACKAGED AIR CONDITIONER

Suction lines. Capillary tube. Light wall special temper tube. Finned tube and plain. All these Wolverine products have important places in the evaporative and condensing units which are the hearts of Chrysler air conditioning systems. You'll find Wolverine products in most Chrysler units.

Chrysler is famous for firsts in air conditioning research and development, just as Wolverine has paced the field in pioneering tubing ideas and products to serve the industry. Important Wolverine developments for all industries include Wolverine Trufin®, the integral finned tube; Wolverine Capilator®, the capillary tube for precision metering of liquids and gases, and light wall special temper tubing.

When you specify Wolverine seamless copper, copper alloy or aluminum tube—you are cashing in on the high quality and outstanding service that only experience can give. Write for complete information as to how Wolverine can help you. Do it now.

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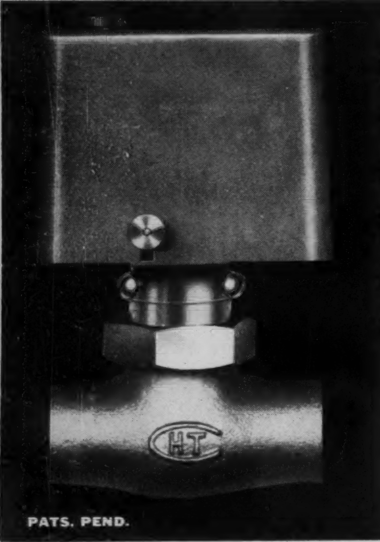
WOLVERINE
PRIME SURFACE TUBE
WOLVERINE CAPILATOR®
WOLVERINE TRUFIN
TYPE S/T



PACKLESS
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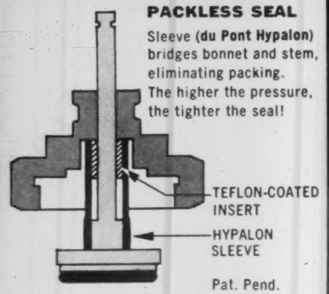


PACKLESS SEAL
Sleeve (**du Pont Hypalon**) bridges bonnet and stem, eliminating packing. The higher the pressure, the tighter the seal!

ZONVALVE®

the zone control valve constructed to last!

Engineers and heating men know—it's *construction* that tells the story!

Zonvalve's packless design (Hypalon sleeve and Teflon-coated stem) means no friction—no wear—no adjustments. Zonvalve *can't* leak!

A heavy-duty motor powers Zonvalve. Pinion, spur gear and cam assembly relieves motor strain, guarantees long operating life.

Zonvalve's globe-type construction insures 100% shut-off, providing positive temperature controls with no heat waste through "seepage."

Those are the unique construction features behind Zonvalve's unconditional written five-year guarantee.

Zonvalve is easy to install, and operates with equal efficiency mounted in any position. It is made in all standard pipe and tubing sizes, straight and angle, from ½" to 1¼". Hand-size compactness permits installation in space as small as a baseboard enclosure. And, of course, wiring is low-voltage.

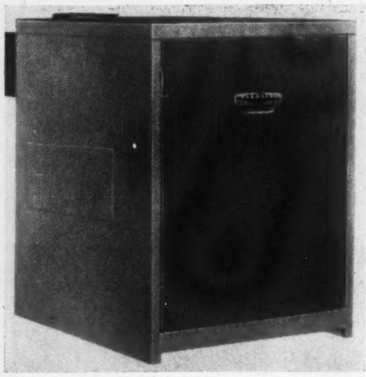
For positive temperature control on steam and hot water systems, for modernization or new construction—specify Zonvalve, install Zonvalve.

Write for informative Brochure P-10.

Zonvalve's Trade-Mark is your guarantee of positive zone control. Accept no substitute!

HEAT-TIMER CORP. 657 BROADWAY, NEW YORK 12, N. Y.
MFRS. OF HEATING CONTROLS SINCE 1937

IN CANADA: HEAT-TIMER CO. · 767 WARDEN AVE., SCARBOROUGH · TORONTO, ONT.



Gas-Fired Boiler . . .

. . . cast iron unit available in sizes from 90,000 to 360,000 Btu per hr input; 35 in. high, models come knocked-down with factory assembled and tested sections; smaller units come in packaged models; all models except 90,000 Btu per hr input have provision for tankless copper water coil to produce domestic hot water — *Peerless Heater Co., Boyertown, Pa.*

Resistant Coating . . .

. . . prevents condensation with use of surface insulation and absorption of small amounts of moisture followed by later release as humidity drops; rock-hard, off-white film can be applied to most metals and building materials by brushing or spraying; bulletin "1" available on request — *Chemical Concentrates, Fort Washington, Pa.*

Selector Switches . . .

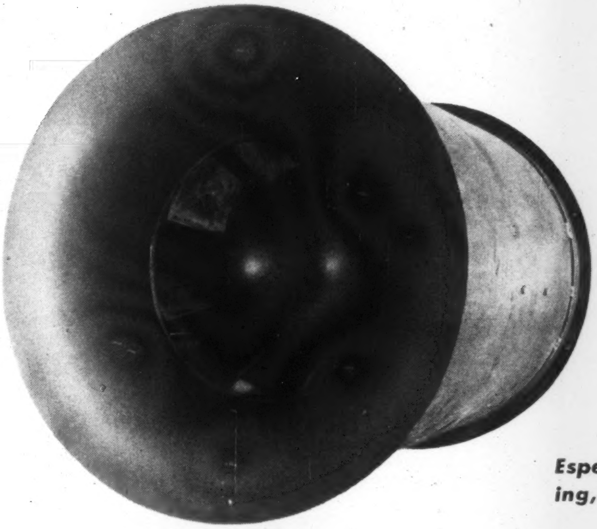
. . . rotary, key, and push-button units for thermocouple and resistance thermometer applications; provides rapid, accurate switching from one to 144 sensing elements; rotary models have capacity for 6, 12, or 24 points; key switches available with either locking or non-locking construction; push-button models have interlocking action — *Thermo Electric Co., Inc., Saddle Brook, N.J.*

ANNOUNCING —

THE NEW, REVOLUTIONARY

MAC FAN

(Mixed-Axial-Centrifugal)



- **Continually Rising Pressure Curve**
- **Non-Overloading HP Curve**
- **Spin-Free Air Delivery**
- **Compact**
- **Integral Unit**
- **Easy Installation**

Especially designed for Ventilating, Air Conditioning, Commercial and Industrial Applications

Investigate the new, aerodynamically designed, economical, space-saving integral fan now. Complete line of sizes with capacities to 200,000 cfm.

Selected territories available for qualified sales representatives.

Write today for free Technical Data Bulletin.

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MISSILE DYNAMICS CORPORATION

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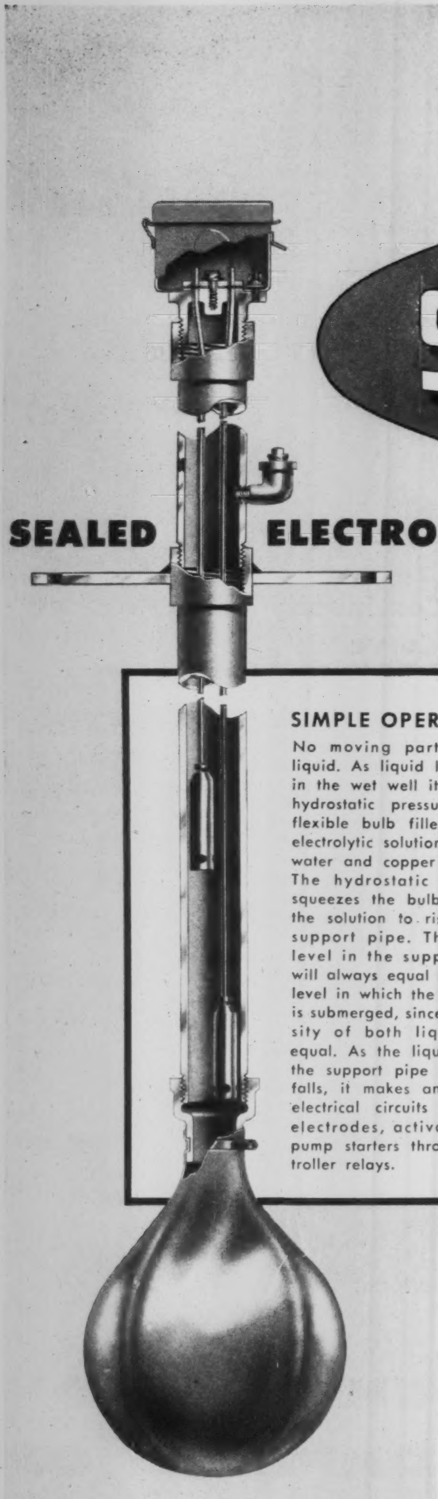
SEALED ELECTRODE FLOATLESS PUMP CONTROLLER

A new and valuable accessory for Sewage And Drainage Sump Pumps . . . exclusively available with "Chicago" Pumps.



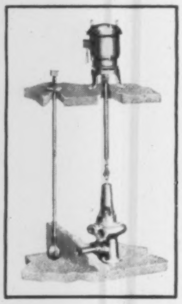
The SEALTRODE* Sealed Electrode Floatless Pump Controller has every advantage of other floatless controllers, plus these advantages of being sealed:

- Electrodes never become insulated and coated with grease, oil or soap.
- Electrodes are never affected by corrosive elements in sewage and drainage water.
- No moving parts in liquid.
- Low original cost . . . eliminates need for duplex float switches and float guide pipes.
- Low maintenance cost.

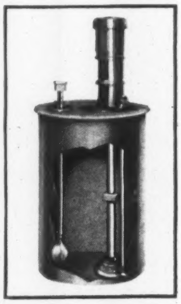
SIMPLE OPERATION

No moving parts in the liquid. As liquid level rises in the wet well it exerts a hydrostatic pressure on a flexible bulb filled with a electrolytic solution of clear water and copper sulphate. The hydrostatic pressure squeezes the bulb, causing the solution to rise in the support pipe. The liquid level in the support pipe will always equal the liquid level in which the controller is submerged, since the density of both liquids are equal. As the liquid within the support pipe rises and falls, it makes and breaks electrical circuits with the electrodes, activating the pump starters through controller relays.

TYPICAL PUMP APPLICATIONS



SEWAGE PUMP



SUMP PUMP

PATENT No. 2,797,702

Write direct, or contact Chicago Pump Company Distributors located in most principal cities, for bulletins and complete engineering data.

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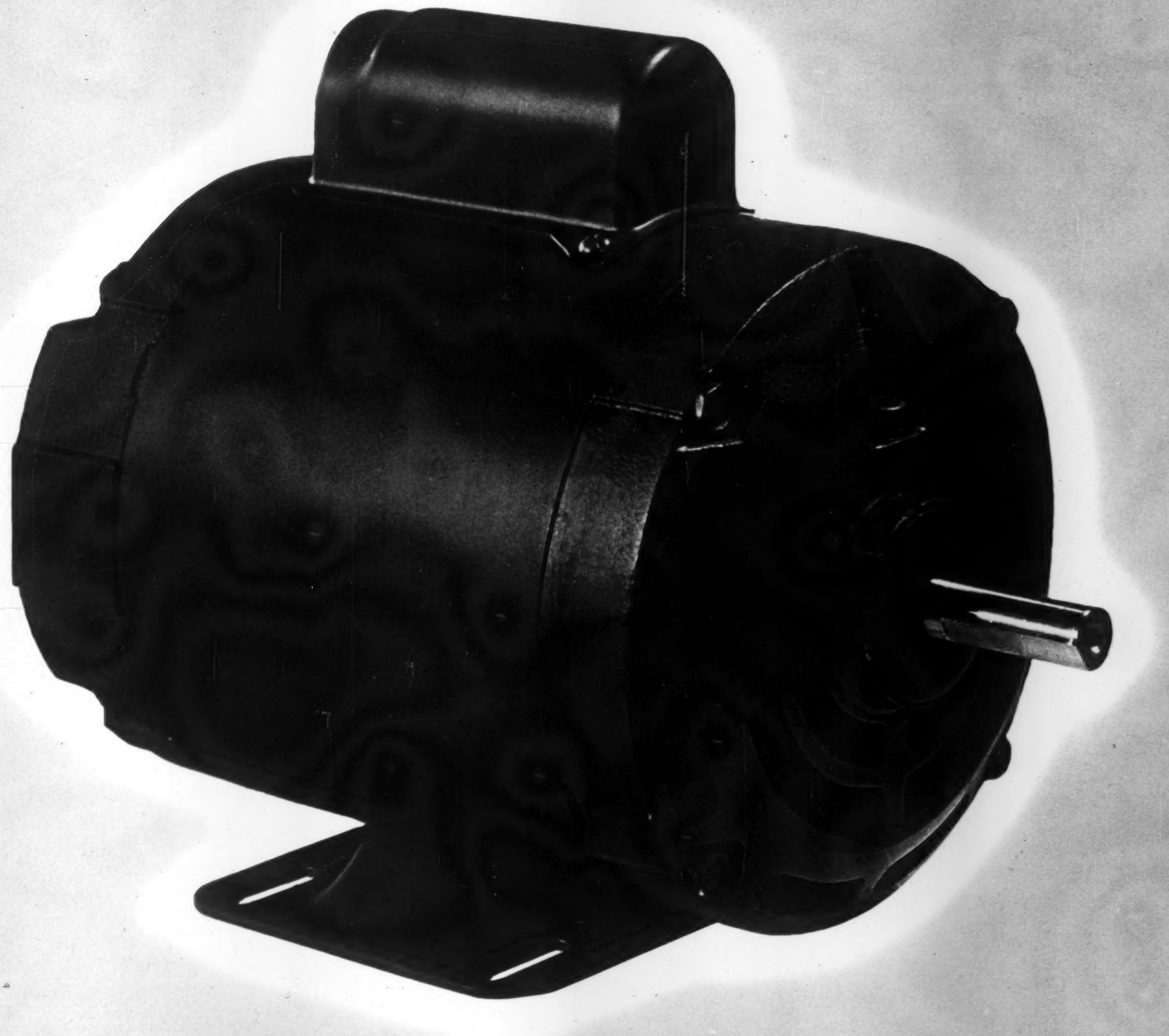

A NEW Duty Master FHP.

for heavy-duty industrial use

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MASTER
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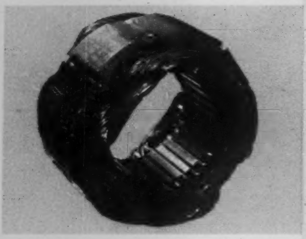
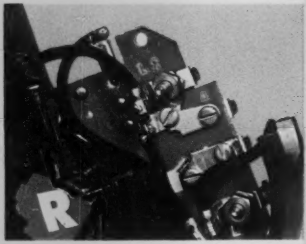
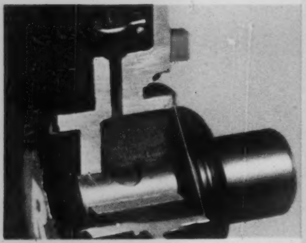
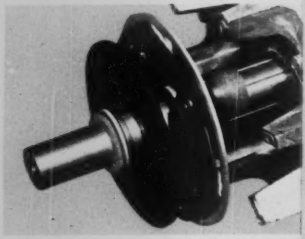
A NEW
Duty Master FHP.


PROTECTED STATOR


TERMINAL BOARD


SLEEVE BEARING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TOUGH . . . COMPACT . . . COOL!

A motor that combines new, most-wanted features at no extra cost

Duty Master:

This motor is tough all over . . . deliberately designed for heavy industrial duty. Frame is rolled from steel—end shields cast from an aluminum alloy specifically selected for strength. Ball bearings are double-shielded, with lubricant packed into the bearing for life. Sleeve bearings are steel-backed and babbitt-lined for low friction and long wear. "Permawick" oil retaining material provides maximum lubrication to these bearings. Rotor is pressure-cast from high purity, low-resistance aluminum. Varnish impregnated stator resists moisture . . . and adds strength to windings.

Duty Master:

More power per pound . . . simple installation, 33% lighter than other preceding motor designs. Good design and materials make the difference. Makers of motor-driven products save on shipping and handling costs. Duty Master's light weight and small size make possible lighter, less complex mounting on equipment. Terminal board provides easy power connection in the front end shield. Cover plate quickly removable. Motor rotation easily reversed by interchanging slip-on connections.

Duty Master:

Up to 10% cooler than other comparably rated motors . . . yet gives you maximum protection. High load capacity results from new, effective ventilation of critical heat sources. Laminations, coils and rotor are literally rinsed with cooling air through new end shield design. In totally-enclosed, non-ventilated motors, the fan, cast integrally with rotor, circulates the air within the motor at a rate appropriate to efficient transfer of heat to motor frame and end shield. And load carrying capacity of the totally-enclosed fan-cooled motor is increased by a fan and shroud directing air over the frame and end shield.

Duty Master:

Quiet . . . Smooth . . . Positive. Resilient mounting composed of metal-rimmed, rubber-cushioning rings that encircle the bearing hubs on each end and support the motor. Motor can be mounted in any position. Single phase starter winding circuit automatically opens at 80% of full load speed. Action is quiet and positive.

Available now in 48 and 56 frame sizes, from conveniently located stocks. Duty Master FHP. is made in ⅛, ⅙, ¼, ⅓, ½ and ¾ hp. capacitor-start, split-phase and polyphase for 48 and 56 frames; repulsion-start induction-run in 56 frame. Your Reliance Sales Engineer or Distributor has all the facts at his finger tips. Call him or write for Bulletin B-2514. It will be sent to you promptly.

B-1675

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RELIANCE ELECTRIC AND ENGINEERING CO.

CLEVELAND 17, OHIO
Canadian Division: Toronto, Ontario
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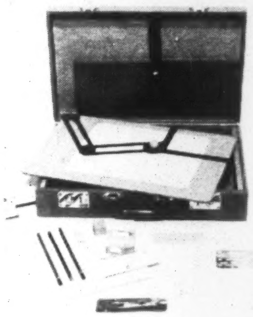
Duty Master A-c. Motors, Master Gearmotors, Reeves Drives, V★S Drives, Super 'T' D-c. Motors, Generators, Controls and Engineered Drive Systems.

EQUIPMENT DEVELOPMENTS

Continued

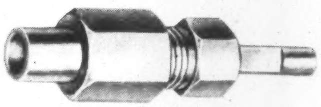


Drafting Kit . . .

. . . portable 14 piece kit features "Draftette" instrument that serves as drawing board, T-square, triangle, and protractor; vinyl covered attaché case — *Retake Inc., P.O. Box 5336, Pasadena 8, Calif.*

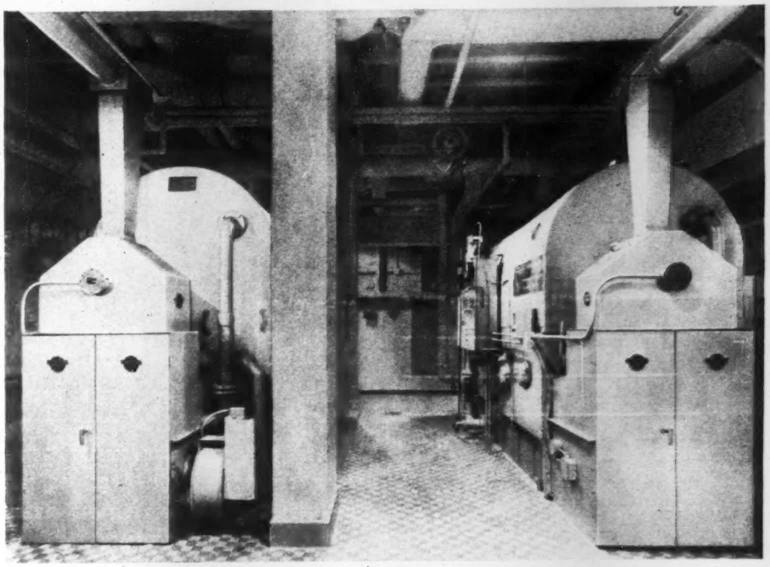
Refrigerant . . .

. . . called "Isotron 13" for low temperature environmental applications, is monochlorotrifluoromethane, can be used to produce temperatures below −100 F for low temperature research; available in 5, 23, and 80 lb cylinders — *Isotron Dept., Pensalt Chemicals Corp., 3 Penn Center, Philadelphia 2, Pa.*



Vacuum Couplings . . .

. . . designed for ultra-high efficiency; no leaks detectable or measurable on a helium mass spectrometer with a sensitivity of 1.7 × 10^{-10} atm cc/sec/division; all metallic unit permits operation at elevated temperatures; available in sizes for $\frac{1}{8}$ through $\frac{5}{8}$ in. OD tube — *Cajon Machine Co., 902 E. 140th St., Cleveland 10, O.*



COAL ECONOMY + PACKAGE EFFICIENCY WITH THE COAL-PAK AUTOMATIC

All the advantages of a package water tube generator plus the economy of bituminous coal . . . that in brief is the significance of the Coal-Pak Automatic, developed in conjunction with Bituminous Coal Research, Inc. Fully automatic controls regulate coal feed, combustion and ash removal with cleanliness and efficiency which cannot be matched.

One of the many outstanding installations of Coal-Pak Automatics is in the new Coal Building, Washington, D. C., headquarters of National Coal Association. In addition to their heating role, the two 71-hp package units illustrated generate low-pressure steam which activates the absorption-type air conditioning system. Be sure to see this trend-setting Coal-Pak installation when you are in Washington, D. C.

Coal Building
1130 Seventeenth St. N. W.,
Washington 6, D. C.

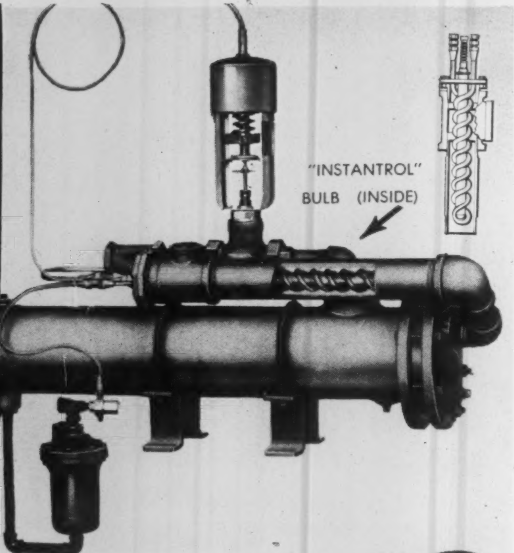
For full information about the remarkable economy of International-BCR Coal-Pak Automatic units, write today for Bulletin 1100.

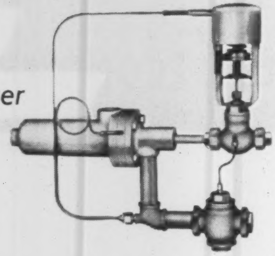
IBW BOILER BUILDERS SINCE 1886

THE INTERNATIONAL BOILER WORKS CO.

810 Spruce St. East Stroudsburg, Pa.

Steel Firebox Heating & Power Boilers
Low & High Pressure Water Tube Package Boilers • International-LaMont Forced Recirculation Generators • ASME Code Pressure Vessels & Welded Products.





INSTANT HOT WATER FOR ALL NEEDS

Instantrol Regulator Assembly

Hot/Cold Water Mixer

Approved in schools, hospitals and industrial plants, this Robertshaw team keeps its users in hot water—and the contractor out of it!

The heat-anticipating Instantrol bulb provides instant hot water under perfect control, *regardless of widely fluctuating load changes.* Adjustable within 90°-200° F. limits, the Instantrol Regulator Assembly includes patented anticipating bulb, "dead end" valve, necessary tubing, etc. It is also available as a complete Heater Package, ready for installation.

In typical applications, the Instantrol Assembly supplies constant hot water for dishwashers, sterilizers and high-temperature processes—and the Hot/Cold Water Mixer tempers this same supply to the lower temperature requirements of shower rooms, wash basins, etc.

Write for full specifications on these and other dependable Robertshaw Controls for the building maintenance field.

Ask for Catalog TH-1700.

Robertshaw

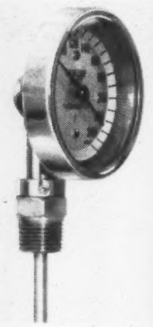
MR. CONTROLS

Robertshaw-Fulton Controls Company

FULTON SYLPHON DIVISION • KNOXVILLE 1, TENNESSEE

EQUIPMENT DEVELOPMENTS

Continued

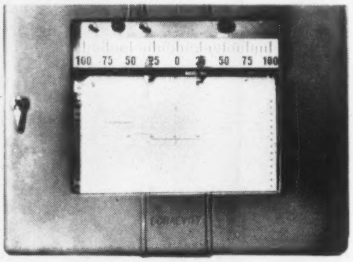


Industrial Thermometers

. . . anti-parallax face design permits reading from any angle; heavy gage all stainless steel cases; eternal pointer calibration, with adjustment of the pointer so scale is always upright; hermetically sealed; silicone dampening stabilizes pointers against vibration — *Moeller Instrument Co., 132nd St. 89th Ave., Richmond Hill 18, N.Y.*

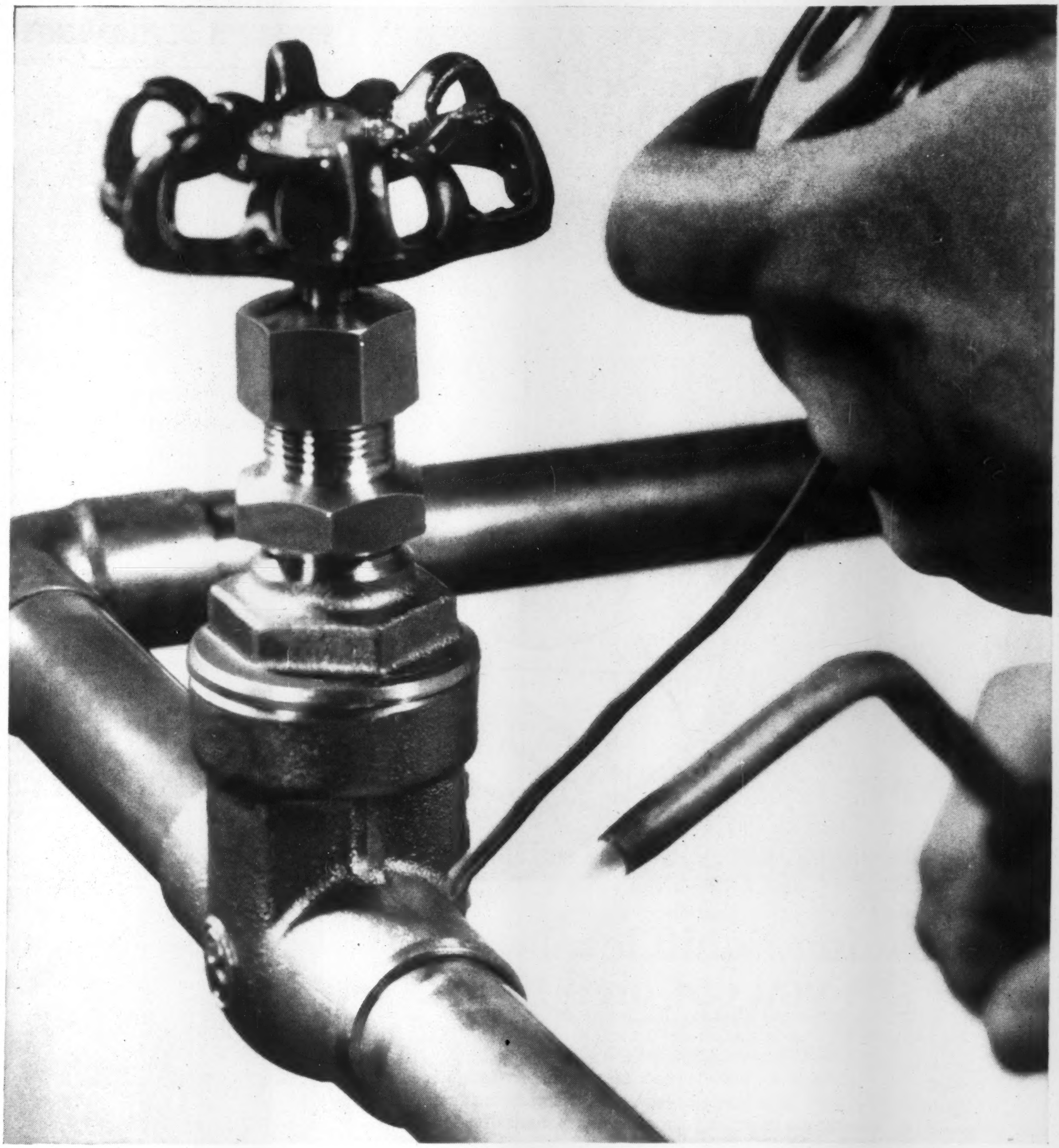
Baseboard Radiation . . .

. . . unit is 10 in. high with copper tubing and aluminum fin combination element in 3/4 and 1 in. sizes; available in standard 8-ft or special job-site pre-cut lengths — *Federal Boiler Co., Inc., Granite and West Sts., Midland Park, N.J.*



Strip Chart Recorders . . .

. . . for use in indicating, recording, or controlling dimensional variables; features null balance principle as method of measurement; single and double pen units; 12 in. wide by 122 ft long chart with 11 in. calibrated recording surface — *Schaevitz Engineering, Rt. 130 at Schaevitz Blvd., Pennsauken, N.J.*



Ohio Brass
O-B VALVES

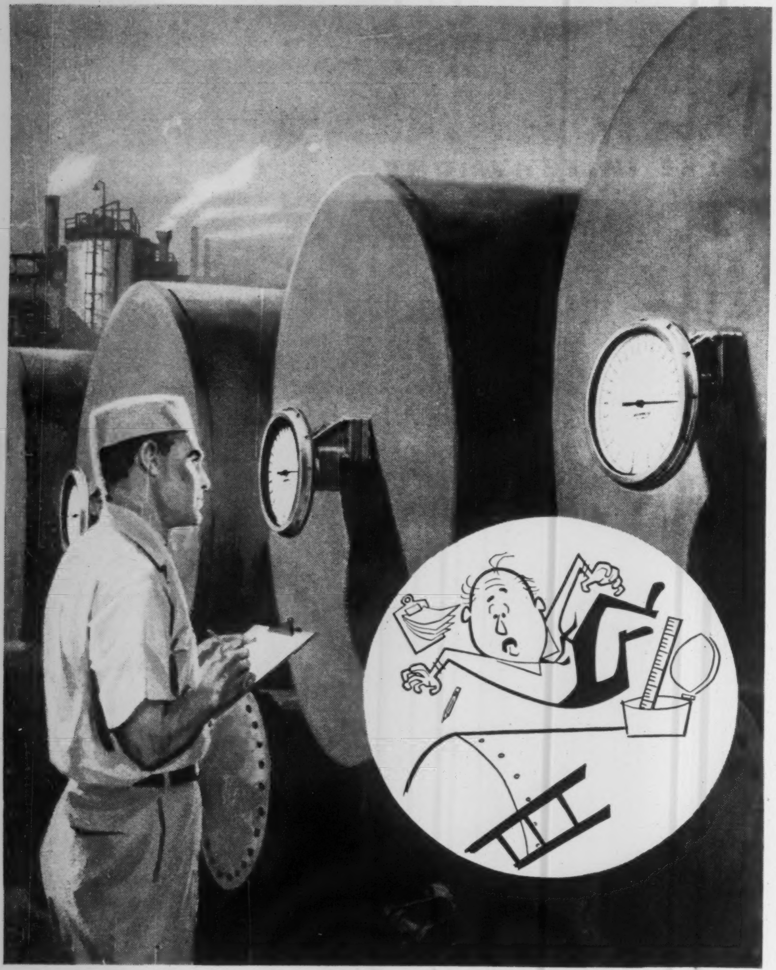
MEN WHO INSTALL O-B solder end valves know the O-B design lets tube ends reach heat uniformly with minimum torch time. Solder flow is smooth. Maintenance is minimized. Continuous service is assured by a safe, leak-tight joint. Ask your distributor for the valve in the orange-and-black box.

OHIO BRASS COMPANY • Mansfield, Ohio

O·B VALVES

HOLAN

10074-V



Reading liquid levels got you out on a limb?

Not if an easy-to-read Liquidometer Gauge is used to indicate exact levels at a glance. It's as simple as telling time...ends potentially dangerous dip-sticking.

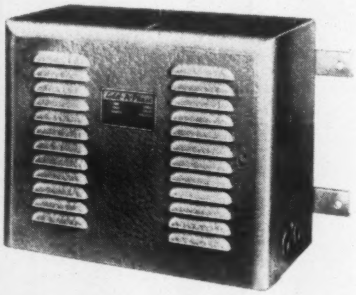
Liquidometer Gauges enable one man to read liquid levels safely and precisely—keeping a continuous, right-at-hand inventory—without risking life and limb.

Take the hazards out of liquid measurement—save time, too—by installing reliable Liquidometer Gauges. There is a type available for practically every liquid measuring application.

LIQUIDOMETER INSTRUMENTS

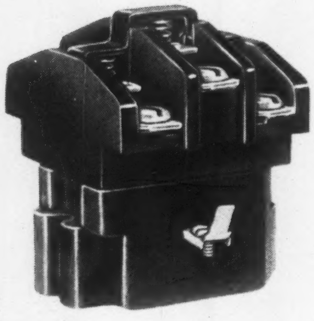
For complete details, write

THE LIQUIDOMETER CORP.
Dept. A, LONG ISLAND CITY 1, NEW YORK



Power Converter . . .

. . . permits operation of any number of 3-phase motors through single conversion system; motors can be operated singly or simultaneously, and will attain 100 percent rated hp; transformer stations available in sizes from 1 to 80 hp; panel controls feature separate hp ratings to match each motor in system; multi-motor unit will operate 220 or 440 v 3-phase equipment from 220 single phase lines — *Add-A-Phase, Div. of System Analyzer Corp., Nokomis, Ill.*



Magnetic Contactor . . .

. . . two and three pole 25 amp units. 2 in. wide × $2\frac{3}{8}$ in. long × $2\frac{1}{2}$ in. high; coil terminals combination snap on, solder and pressure type; line and load terminals pressure type; silver-cadmium oxide contacts, encapsulated coil, magnet assembly and 600 v spacing; bulletin 41-B4 available on request — *Furnas Electric Co., 1041 McKee St., Batavia, Ill.*

Marsh Presents

A Superior Adjustable Orifice Valve

Here is the answer to easy, highly efficient balancing of both steam and hot water systems . . . a radiator valve in which you can accurately adjust orifice opening with the twist of a screwdriver; without shutting down the system; without breaking the union connection.

A stop screw in the valve stem, as illustrated here, enables you to set the modulating cone for any required flow: on steam, from 10 to 100 sq. ft. E.D.R.; on hot water, to any indicated flow at any given pressure.

Read opposite how simply and effectively the flow is adjusted. Once the opening is set, the special taper of the modulating cone assures the correct flow of steam or water through the orifice at any opening. In other words, the flow curve through the valve at *any* given pressure is a *straight line* throughout the full range of valve opening. Since the adjustment only limits the amount of opening, shut-off is positive at any adjustment without disrupting orifice setting.

A new valve with time-tried Marsh design

This feature is all the more significant because it is found in a valve that incorporates the truly packless, metal-to-metal seal construction so highly respected in the Marsh R-100 series and now brought to still higher standards.

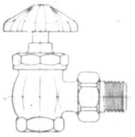
The new adjustable R-105 series is available in ½″, ¾″ and 1″ sizes; angle, straightway, and corner patterns. Ask for special bulletin.

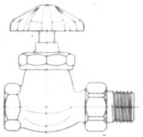
MARSH INSTRUMENT CO., Skokie, Illinois
Division of Colorado Oil & Gas Corporation, Dept. T
Marsh Instrument & Valve Co., (Canada) Ltd., 8407 103rd St., Edmonton, Alberta, Canada; Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas.

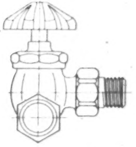
The stop screw in the sectional view below provides the orifice adjustment. Simply close the valve, remove the handle-screw and insert screwdriver in the open stem to engage slot in stop screw. Turn the stop screw as far down as it will go. Then back it off to the required orifice opening.

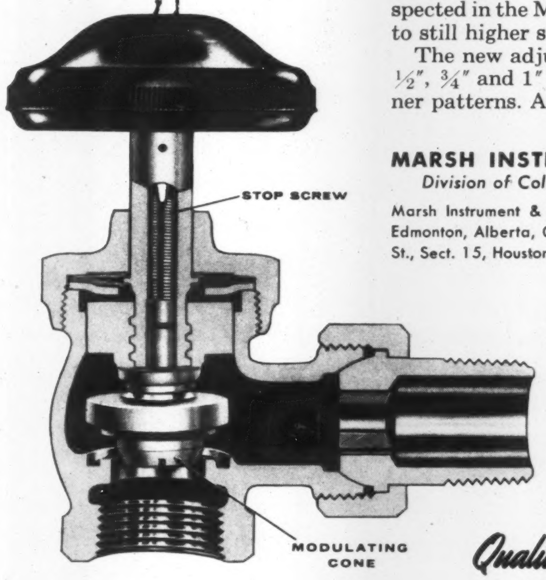
In a steam system, back stop screw one turn for each 10 sq. ft. of direct radiation. In a hot water system, as many turns as indicated by flow requirements of system, either precalculated or checked by devices for determining flow.

Note that valve is non-rising stem type and can only be opened to position permitted by stop screw setting. Provision is made for sealing the adjustment tamper-proof after setting orifice.


Angle

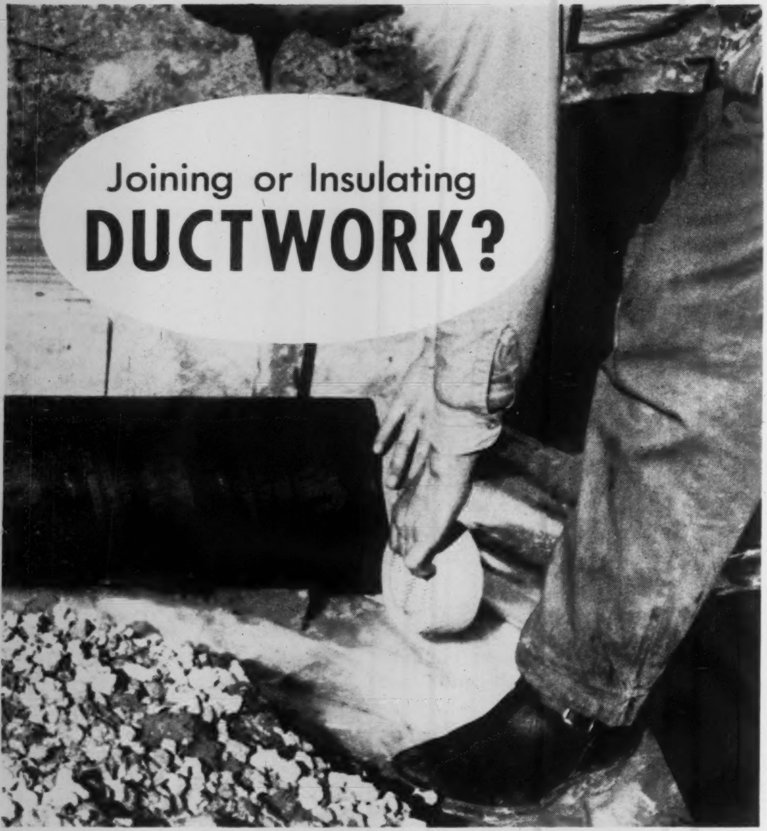

Straightway


Corner—either right or left hand



MARSH

Quality Heating Specialties since 1865



Do it quicker, neater . . . with

Shuford's SHURTAPE® MP-26

Metallized Paper Insulation Tape

Shuford's
SHURTAPE

To save yourself time and money on the job, use Shuford's SHURTAPE MP-26 for holding insulation to ductwork and for sealing joints of metal or fibre duct.

This silver-colored tape is especially designed for use in heating and air conditioning installations. It's inexpensive, easily applied, and you get an inconspicuous, positive seal with a neat finished appearance. Faster than staples—looks better too!

SHURTAPE MP-26 is treated with flame-inhibiting chemicals to retard inflammability. It has excellent resistance to water and abrasion, resists solvents and oils, and its moisture vapor transfer rate is virtually nil.

For complete information, write

CLOTHES LINES • TWINES
PRESSURE-SENSITIVE PAPER TAPES
SASH CORDS • WEATHER STRIPPING
COTTON & RAYON YARNS • EXTRUDED PLASTICS

Shuford SINCE 1880 **Mills, INC.**
HICKORY, N. C.

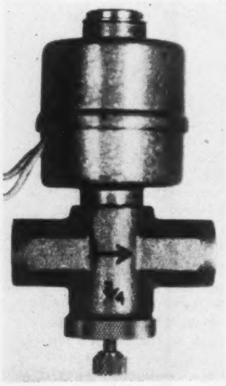
5077

EQUIPMENT DEVELOPMENTS

Continued

Pipe Caulking . . .

. . . epoxy-based compound for caulking bell & spigot type pipe, particularly joints in acid waste lines; troweled into place, does not require heat for cure, and sets up without shrinkage to a tough solid; resistant to virtually all reagents used in school and industrial labs — *Adams Chemical Corp., 120 Center St., El Segundo, Calif.*



Zoning Valve . . .

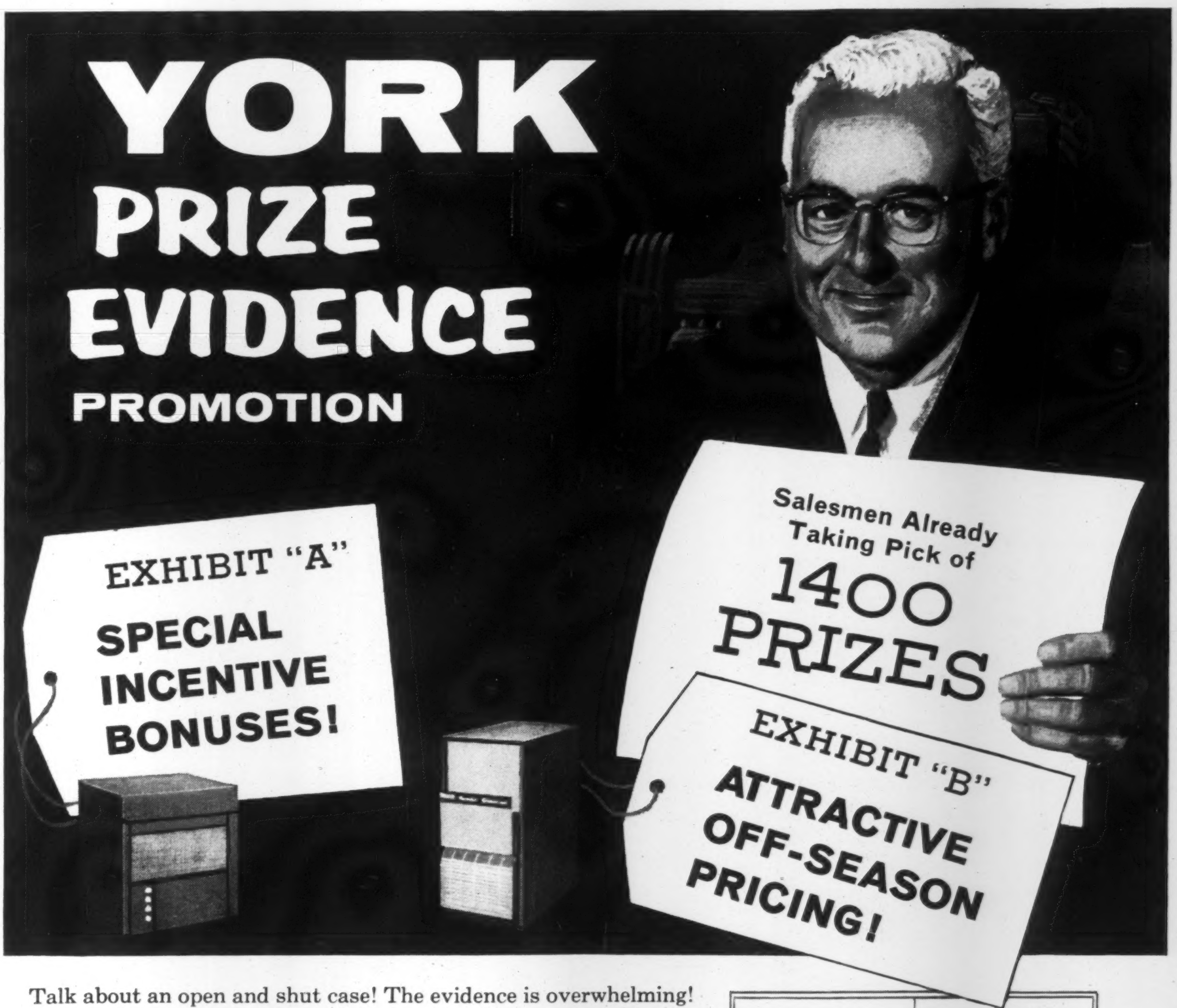
. . . for both heating and cooling, has single moving part magnetically actuated and completely immersed and damped in fluid; can be used with any standard low voltage, two-wire thermostat, and requires two connections; external thumb screw permits manual operation without tools in case of power failure — *Hydrotherm Inc., Dept. AC-7 Northvale, N.J.*

Hand Nibbler . . .

. . . features cutting speed of 35 in. per minute through 1/4 in. steel plate; also cuts hot or cold rolled steel and up to 5/16 in. aluminum; minimum cutting radius, eight in.; 2½ hp motor, a-c or d-c, operating on 115 v, 60 cycle; unit weighs 20 lb and has overall measurement of 13-½ in — *Fenway Machine Co., 3107 N. Broad St., Philadelphia, Pa.*

EVERYBODY WANTS IN

ON HOTTEST OFF-SEASON "ACTION" IN AIR CONDITIONING HISTORY!


YORK
PRIZE
EVIDENCE
PROMOTION
EXHIBIT "A"
SPECIAL INCENTIVE BONUSES!
Salesmen Already Taking Pick of
1400 PRIZES
EXHIBIT "B"
ATTRACTIVE OFF-SEASON PRICING!

Talk about an open and shut case! The evidence is overwhelming! Special off-season pricing on all York residential and commercial air conditioners...a complete direct mail program to really pull in the traffic...easy, easy Skip-Payment Financing Plan... 1400 fabulous incentive prizes to keep salesmen fired up...double point value for all commercial units sold under Lease Plan! No wonder everybody wants *in!* No wonder York Air Conditioners are moving as never before at this time of year. Get the whole eye-opening testimony from your York Distributor now.

COURT ALREADY IN SESSION

Sept. 6 to Nov. 26

HURRY! HURRY! HURRY!

YORK®

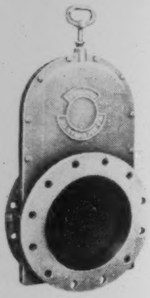
THE QUALITY NAME
IN AIR CONDITIONING,
HEATING AND REFRIGERATION

York BW

YORK CORP., SUBSIDIARY OF BORG-WARNER CORP. WEST GRANTLEY ROAD, YORK, PA

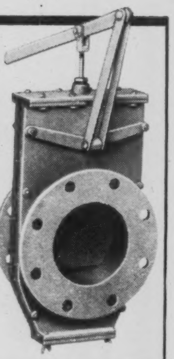
ROCKWELL
SLIDE VALVES

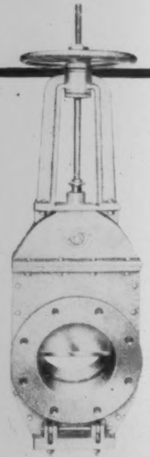
for GASES
SLURRIES OR FREE-
FLOWING SOLIDS
THAT CLOG OR JAM
OTHER VALVES...



Standard Slide Valve, screwed end type or flanged (shown); when fully open, valve offers no restriction to fluid flow. Bulletin 500R.

"Kwikleen" Slide Valve—Not necessary to remove from line for cleaning. Sediment discharged at bottom. Complete cleanout by attaching steam, water or air line to plug hole in valve body. Bulletin 501R.

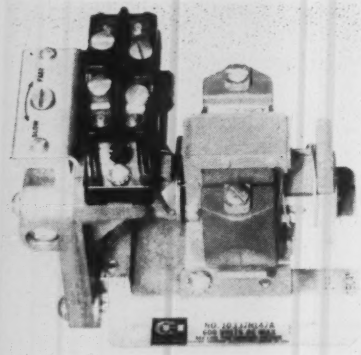




Heavy Duty "Kwikleen" Valve for line pressures to 60 psi. Blade not exposed when in fully open position. Ideal for pulp stock, slurries, dust, fly ash, scale, granular materials. Bulletin 508.

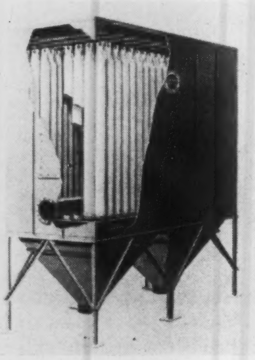
W. S. ROCKWELL CO.
2700 Eliot St., Fairfield, Conn.

EQUIPMENT DEVELOPMENTS
Continued



Timing Relay . . .

. . . one-minute pneumatic unit for sequence controls; diaphragm assembly eliminates need for exhaust valve; self-cleaning filter system protects timing assembly; adjustment range from 0.2 to 60 sec; switch suitable for pilot and control circuit duty to maximum 600 v; bulletin LO-71 available on request — *Cutler-Hammer, 421 N. 12th St., Milwaukee 1, Wis.*



Dust Collectors . . .

. . . available in two size ranges, fabric envelope type for low gas volume, envelope type for high gas volume; capacities from 100 to 48,000 cfm, with larger volumes attained by combination of standard units; 99.9 percent efficiency; filter bags available in variety of fabrics; bulletin No. 150 available on request — *John Wood Co., Air Pollution Control Div., Essex Building, Bernardsville, N.J.*

SARCO

Here are 7 Sound Reasons
Why the Thermo-Dynamic®
Does a Better Job of Trapping

SARCO
Thermo-
Dynamic
STEAM TRAP
U.S. PAT. No. 2,817,353

1. *Simplicity*—has only one moving part. 2. *Maintenance*—practically zero. 3. *Wide pressure range*—one trap for all pressures from 10 to 600 psi. 4. *Uniform performance*—operates equally well on heavy, light, or no condensate load. 5. *Operates against back pressures*—up to 50% of inlet pressure. 6. *Rugged*—unaffected by superheat, water hammer, vibration, or corrosive condensate. 7. *Minimizes inventory* of spare parts.

Maintenance Time: 40 Seconds. If it now takes your maintenance crew more than a couple of minutes to service an ordinary trap, you're throwing away valuable time. This Sarco Thermo-Dynamic can be cleaned, blown out if necessary, and reassembled on the line in as little as 40 seconds.

For Prompt Information on the TD-50 . . . or for fast help on the efficient solution of any steam trapping problems, get in touch with a SARCO District Office, Sales Representative, or Distributor. (There's one near you.)

Only SARCO makes all 5 types:
Thermo-Dynamic* • Thermostatic • Liquid Expansion • Float Thermostatic • Inverted Bucket

*U.S. Pat. No. 2,817,353 TM Reg. U.S. Pat. Off. 1409

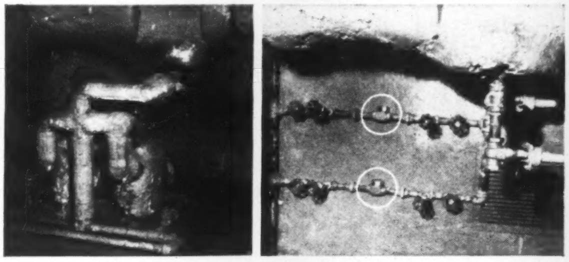
SARCO
COMPANY, INC.
635 Madison Ave., New York 22, N. Y.

SARCO TOPICS

How Major New York office building solved steam trapping problems through trap standardization

Recently, the Office Building at 625 Madison Avenue, New York, — erected in 1931 and comprising 420,000 square feet on 17 floors — discontinued its own steam generation and switched to district steam. The changeover made the inadequacies of old bucket and float traps more apparent than ever, and afforded an occasion to modernize trapping. Here's how major improvements were made.

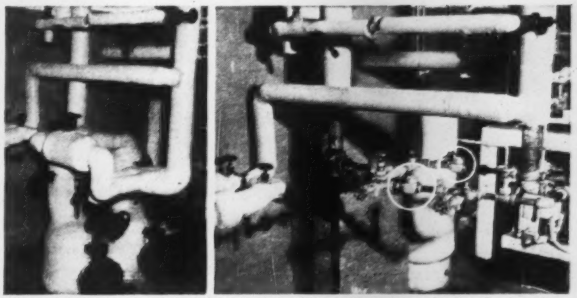
The first problem was maintenance. All maintenance had to be done at night or on weekends, at overtime rates, because the system could not be shut down during business hours. Frequent breakdowns added to maintenance costs. After the installation of Sarco Thermo-Dynamic Steam Traps, Type TD-50, trap maintenance — and therefore maintenance costs — have been reduced almost to zero. The engine room crew are now free for other jobs, and savings in both regular and overtime manhours are considerable.



Left picture shows the steam service main from the street, with massive float trap installation. Picture at the right is view of installation after the changeover to TD-50's (circled).

The second problem was water-hammer, caused by passage of live steam into return lines when traps failed open. (When traps failed closed, water accumulated in steam supply mains and equipment.) Installation of TD-50 steam traps ended waterhammer and consequent damage to equipment, because the TD-50 discharges condensate as rapidly as it is formed and prevents steam from entering the return system.

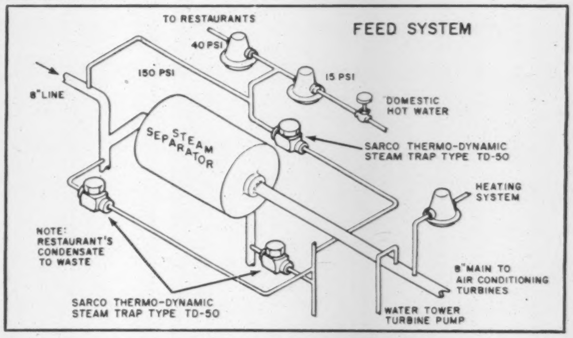
The third problem was live steam loss. Live steam, discharged into the return lines, not only represented a great waste of heat energy, but caused waterhammer in the return, and raised the condensate temperature to an excessive level. (Incidentally, although the building's district steam system is, of course, not faced with this problem, hot condensate passing through condensate pumps can damage pump seals.) These problems are eliminated through the use of TD-50's. No steam can be blown into the return main because the TD-50 shuts off *positively*, blocking any possibility of live steam being discharged into the return. Savings are considerable.



View at left shows original installation of huge float traps in the feed system of the building. View at the right shows compact installation of Sarco TD-50 Steam Traps (circled).

These benefits were achieved by replacing bucket and float traps with Sarco Thermo-Dynamic Steam Traps, Type TD-50, matched and correctly sized to the application. For example, many ½" bucket traps were replaced with ⅜" TD-50's, which have ample capacity for the job.

The TD-50's pressure range of 10-600 psi made it possible to standardize on one steam trap for a variety of applications that formerly required traps of many different types and pressure ratings. Finally, changeover took only 30 minutes per trap for each compact TD-50 installation.



TO RESTAURANTS
FEED SYSTEM
40 PSI
150 PSI
15 PSI
8" LINE
DOMESTIC HOT WATER
STEAM SEPARATOR
SARCO THERMO-DYNAMIC STEAM TRAP TYPE TD-50
HEATING SYSTEM
NOTE: RESTAURANT'S CONDENSATE TO WASTE
8" MAIN TO AIR CONDITIONING TURBINES
SARCO THERMO-DYNAMIC STEAM TRAP TYPE TD-50
WATER TOWER TURBINE PUMP

Schematic hook-up of the converted feed system.

The success of this TD-50 installation led Collins, Tuttle Co., Inc., managers of the building, to substitute Sarco Thermo-Dynamic Steam Traps for competitive bucket traps in two other major New York buildings.

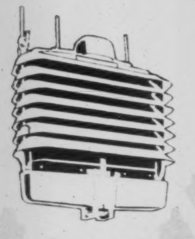
For more information on Sarco Thermo-Dynamic Steam Traps, contact your Sarco Sales Representative or district office, or write.

2165

SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

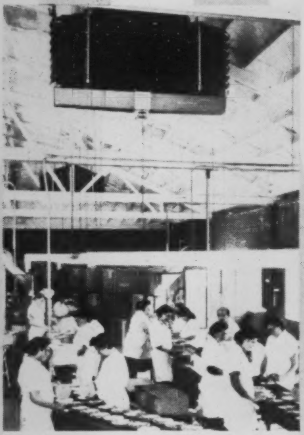
STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES



Bring Sun-Like Heat Into Your Plant With

PANELBLOC

OVERHEAD GAS-FIRED HEATERS



Panelbloc infra-red radiant heaters generate the same type of healthful, warming ray the sun does. Like the sun, it warms anyone and anything in its effective range. Panelbloc warms floors, furniture, machinery and people, NOT the surrounding air.

Panelbloc is low in first cost and easy to install. No electrical connections are needed. There are no fans, motors or blowers. No moving parts mean nothing to wear out.

Panelblocs use any commercially available gas for fuel and are automatic. AGA and UL approved.

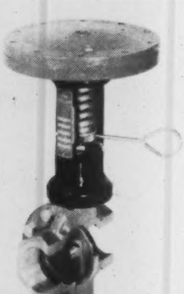
Write for Bulletin PC 1-60 H today

PANELBLOC DIVISION
The BETTCHER MANUFACTURING CORPORATION
3106 West 61st St. Cleveland 2, Ohio

MODERN
ZONAR VALVE
24v. 60 Cycle Operation
STRAINER

Zone Valves . . .

. . . unit's removable strainer protects against dirt and other foreign material; non-strip 24 v 60 cycle motor with built-in click signal protects against valve restriction; valve can be operated manually for gravity flow without disturbing motor assembly; available in three sizes: ¾, 1 and 1-¼ in.; catalog available on request — *Modern Flo-Trol Products Corp., 367 Farmingdale Road, Babylon, L.I., N.Y.*

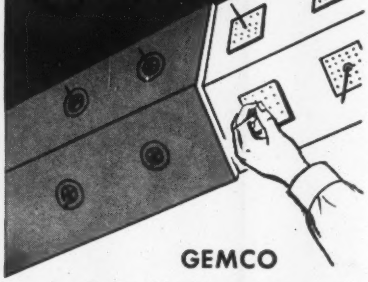


Diaphragm Control Valve

. . . in ¼ to 2 in. sizes, equipped with attached adjusting rod for set point changes made by varying load on main adjusting spring; valve features stainless steel sliding gate seat for tight shut-off, according to manufacturer; bulletins "J-170" and "SRBc 10-60" available on request—*OPW-Jordan Corp., 6013 Wiehe Rd., Cincinnati 13, O.*

SAVE TIME—SAVE MONEY

with these dependable INSULATION HANGERS



GEMCO Spindle Hangers and W-A Self-Locking Washers

Ideal for insulation work, Gemco Spindle Hangers are easily and quickly installed . . . with positive adhesion to concrete, brick or metal. W-A Self-Locking Washers pressed over spindles with minimum effort and lock insulation securely in place.

GEMCO Pronged Hangers

Designed especially for supporting various types of block insulation. Easily applied for positive adhesion. Prongs (available in various lengths from 1 3/16" to 6 7/8") bend over to hold insulation firmly in place.

TUFF-WELD Nylon Hangers

Two-piece hangers . . . with bases of tough, mold nylon and spindles of metal. Made especially for smooth surfaces. Spindles snapped into bases as needed; reduces inventory, storage space, freight costs. W-A Self-locking washers hold insulation securely in place.

TUFF-BOND Quik-Set Adhesive (for smooth or slightly irregular surfaces) and Improved General Purpose Adhesive (for rougher surfaces) assure permanent adhesion of hangers when used as directed. Write or wire for details and specifications.

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INCORPORATED
DANVILLE 28, ILLINOIS

Now RIDGID® Sets The Pace In Tubing Tools, Too!

Long the outstanding quality leader in pipe tools, RIDGID now leads the way in tubing tools. Compare these new RIDGID Tubing Tools with the ones you're now using . . .

Compare them for advanced design . . . quality construction . . . economy. You'll find RIDGID Tubing Tools last longer . . . give the most all 'round value for the money.

Choice of 8 RIDGID® Tubing Cutters

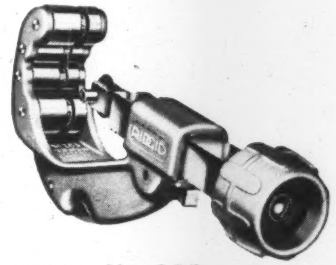
For Copper, Brass, Aluminum, Tubing and Thin-Wall Conduit!

RIDGID No. 105 Tubing Cutter

Open or Closed
Only 5″ Long
Full 1/8″ to 1 1/8″ O.D. Capacity

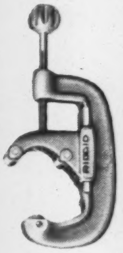
RIDGID Nos. 10, 15 and 20 Tubing Cutters

Lightweight Aluminum Alloy Frames . . . Fold-in Reamers
No. 10—1/8″ to 1″ O.D.
No. 15—3/16″ to 1 1/8″ O.D.
No. 20—1/2″ to 2 1/8″ O.D.



RIDGID No. 205 Tubing Cutter

Fast Slide-to-Size . . .
Instant Trigger Release.
1/8″ to 2 3/8″ O.D. Capacity



RIDGID Nos. 30 and 40 Tubing Cutters

Perfect Tracking . . . No Burrs . . . Aluminum Frame.
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No. 40—2″ to 4″ O.D.

RIDGID No. 315 3-Wheel Tubing Cutter

For Emergency Use Where Full Turn Is Not Possible.
No. 315—3/16″ to 1 1/8″ O.D.

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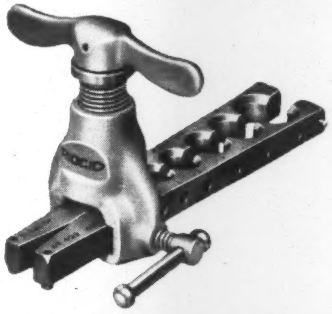

All parts are locked together . . . Automatic feed release . . . Rolling cone action produces smooth, uniform flare walls. 3 models for 45° and 37° S.A.E. flares.

RIDGID No. 457 for 45° flares, 1/8″ to 5/8″ O.D. (7 sizes)
RIDGID No. 459 for 45° flares, 1/8″ to 3/4″ O.D. (9 sizes)
RIDGID No. 376 for 37° flares, 3/16″ to 5/8″ O.D. (6 sizes)

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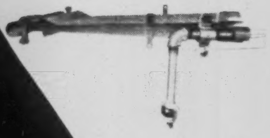

GAS
and/or
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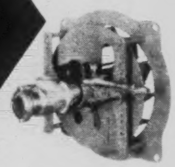
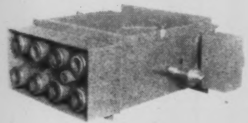
BURNERS





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EQUIPMENT DEVELOPMENTS
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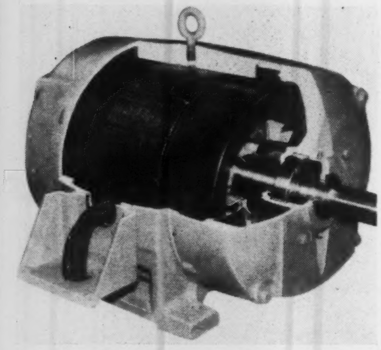
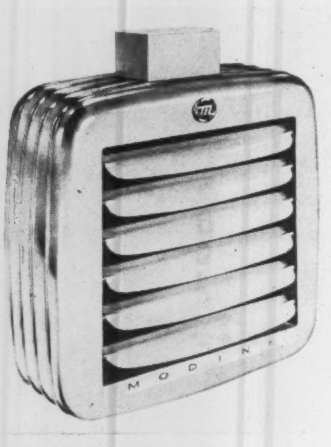


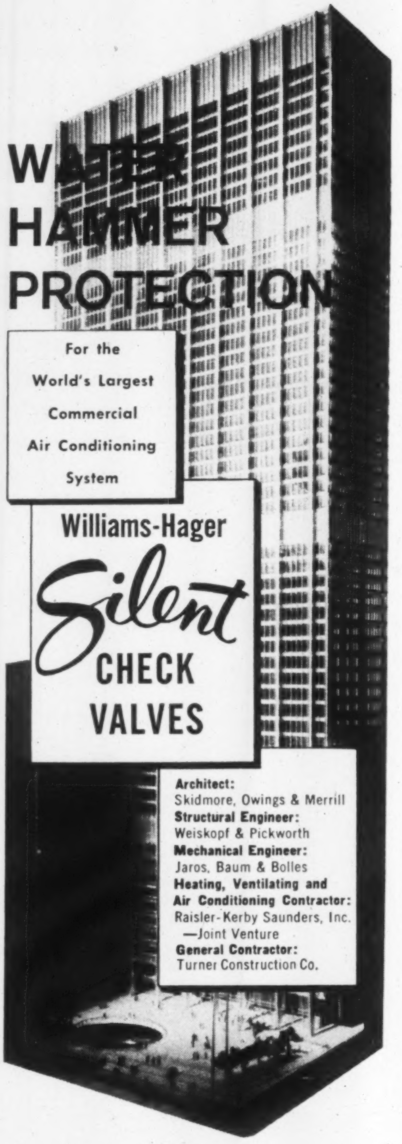
Electric Motors . . .

. . . encapsulated with an epoxy compound, units available in two or three phase, 1 through 125 hp, a-c squirrel-cage; available in NEMA designs A, B, C, and D for one, two, three, or four speed constant or variable torque operation for all standard voltages and frequencies; bulletin "1005 (E, F)" available on request — *Howell Electric Motors Co., 16316 W. Seven Mile Rd., Detroit 35, Mich.*



Unit Heaters . . .

. . . seven electric powered units range in capacities from 5 to 25 kw with models available for 208, 240, 277, and 480 v; heating element consists of steel fins bonded to steel tubes encasing nichrome wires embedded in magnesium-oxide dielectric; built-in limit control prevents overheating; units may be suspended from ceiling or wall by means of optional bracket; bulletin 1060 available on request — *Modine Mfg. Co., 1509 De Koven Ave., Racine, Wis.*



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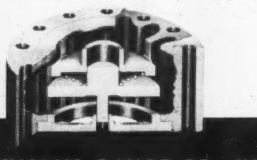
building in New York, a magnificent new 60-story structure, *Silent Check Valves* reliably protect pumps and the piping system against surge pressures and resulting water hammer.

Write for Bulletins: No. 659 on Pressure Loss Tests . . . No. 654 on Valves . . . No. 851 on Cause, Effect and Control of Water Hammer.



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"For a really versatile, **all-purpose** valve, we've found there's none better than R-P&C bar stock valves. Designed and built **for close control service,** the construction of these valves makes them well suited to many general purpose applications as well. For example, the **compactness** of R-P&C bar stock valves is particularly advantageous for close-coupled installations in instrument lines or on panel boards and for pressures up to 10,000 lbs. in steel."

These valves are available in a wide variety of materials to withstand extremely high temperatures and pressures. But best of all, R-P&C bar stock valves are economically priced. This is made possible through special techniques developed by R-P&C.

We highly recommend R-P&C bar stock valves for meter, gauge, sampling, or test valves on equipment requiring a reliable compact valve that can withstand high pressure service.

Contact your R-P&C distributor for full details about bar stock valves in bronze, carbon and stainless steels plus the complete line of R-P&C gate, globe and angle valves in all standard materials.

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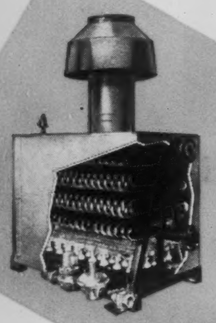
PARKER INDUSTRIAL HOT WATER BOILER

126M to 5,000M B.T.U. Designed specifically for closed circuit application such as building heating and industrial processing. Also available for high temperature liquids up to 600°. Gas, oil and combination gas-oil fired.

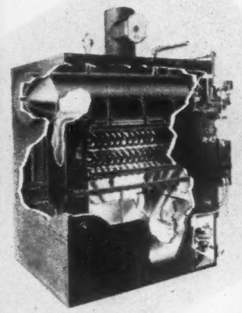


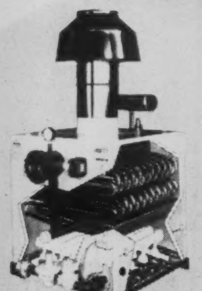
Specify

Install

PARKER HORIZONTAL DRUM STEAM BOILER

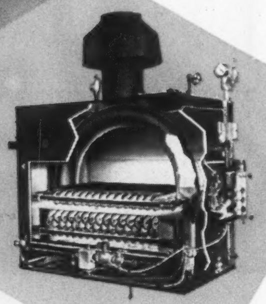
69 to 150 H.P. Full steam pressure generated in less than 10 minutes. Completely packaged for simplicity of installation. Complete internal accessibility. Available in gas, oil, or combination gas-oil firing.





PARKER INDIRECT HOT WATER BOILER

Manufactured in 4 sizes, 264M to 1,152M B.T.U. or 254 to 1,105 gallons per hour 100° rise. The ideal boiler to provide economical rust-free hot water service for swimming pools, apartments, hospitals, laundries, etc. Gas fired only.



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5 to 40 H.P. One of the most popular boilers ever manufactured. Used in all types of industry. Available for gas, oil or combination gas-oil firing.

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A few territories are available for qualified manufacturer's representatives.

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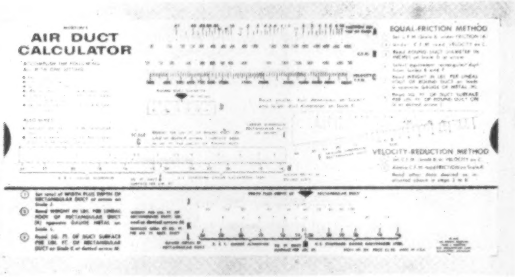
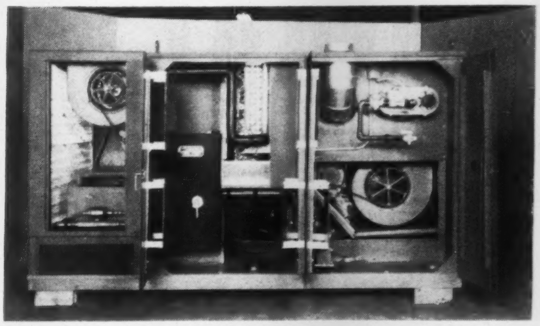


Air Duct Calculator . . .

. . . pocket size, single slide calculator sizes duct by equal-friction or velocity-reduction methods; useful for converting round duct sizes to rectangular, or rectangular to round; surface area data to determine insulation requirements — *Paul S. Morton Engineering Service, 5131 Meadowlark Lane, Kalamazoo, Mich.*

Immersion Heater Unit . . .

. . . electric unit for commercial, industrial use; for water heating equipment of all types; connects to 120 v circuit; features built-in thermostat; temperature range from 100 to 180 F; seven sizes range from 750 to 3000 w; available in sheet-steel housing or heating element and screw plug alone — *Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.*



Packaged Air Conditioners . . .

. . . for roof top mounting, in single cabinet models for up to 500,000 Btu per hr output and 15 tons cooling capacity; feature "uniframe" construction in one piece penthouse design to conform to building silhouette; similar units for up to 1 million Btu per hr heating capacity and 20 to 40 tons cooling are offered in two sections for field connection of water or air cooled condensing units; all are gas or oil fired, catalog "YR-10" available upon request—*Mammoth Furnace Co., 6425 Cambridge St., Minneapolis 16, Minn.*

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PHILADELPHIA
MANUFACTURERS INDUSTRIAL THERMOMETERS
FOR PIPING, HEATING AND AIR CONDITIONING

More than 55 years of experience go into every instrument we make. This gives you accuracy and dependability when you specify the best—PHILADELPHIA Pipe Line and Duct Thermometers. Let our specialists work with you on your problem in our field.

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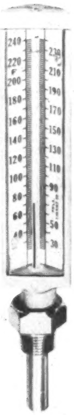

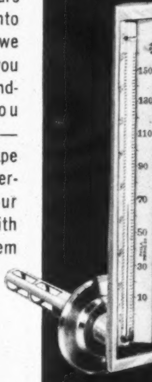

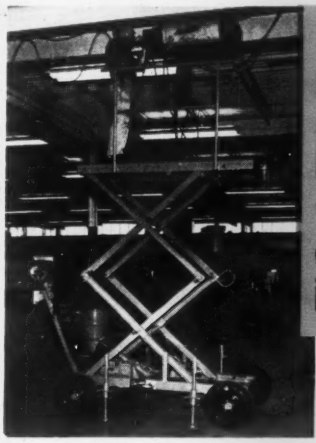

NEW SKY WITCH puts load and workmen at job height!

Work height easily varied with a touch of the controls

Sky Witch, the new ***CHARLES*** *product, is a...*

WORK-LOAD LIFT!

For construction, installation, and overhead maintenance . . . in industrial plants and commercial buildings . . . chemical plants, refineries . . . inside or outside! Sky Witch offers 6 basic models with various power and mounting options. Portable and hydraulic, it lifts the load and serves as an adjustable work platform . . . heights to 24 feet, loads to 2,000 pounds! Write for details.

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$11,000

in fuel savings a year

when Space Heaters replaced steam

This was the problem . . . a plant expansion program had added many square feet to existing structures, plus two new buildings. The present steam heating system was inadequate, so management took a long, hard look at heating costs. Rejuvenating the present boiler or installing a new one large enough to provide both heat and process steam involved a major expenditure. In addition, fuel and maintenance costs were high.

This was the solution . . . sixteen Dravo Warm Air Space Heaters of various sizes were installed. Now all working areas in the plant are held at a comfortable 70°, including offices and receiving room. Cold air is drawn into the heaters at floor level, and discharged *above* workers' heads. Warm air is retained in the work area instead of rising to the roof.

These were the results . . . Fuel savings alone amounted to $11,000 per year, a reduction of 48%. In addition, the costs of full-time boiler room employees, and of boiler and steam line maintenance are saved. Since each heater is controlled by an individual thermostat, working conditions are kept at optimum. In the summer, fresh air is circulated by the heater fans.

Interested . . . in what Dravo Counterflo Heaters can do for you? Mail the coupon for full information on the Case Study outlined above, and on money-saving Dravo Heaters.

DRAVO
CORPORATION

Department H-13, Room M-214
Pittsburgh 25, Pa.

Send me free copy of 12-page report on warm air space heating and the facts on the company mentioned above.

Name____________________________

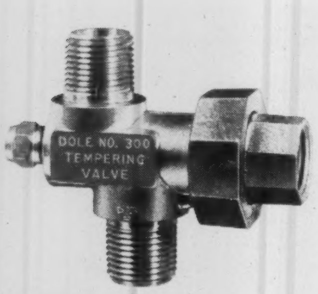
Company__________________________

Address___________________________

City____________Zone____State______

EQUIPMENT DEVELOPMENTS

Continued

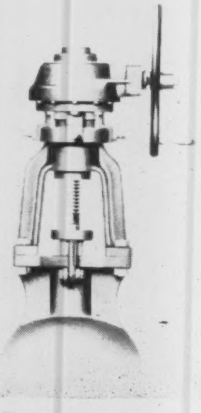


Tempering Valve . . .

. . . adjustable from 120 to 160 F with thermostatic power element; 100 percent hot water can be bypassed to heating units — *The Dole Valve Co., 6201 Oakton St., Morton Grove, Ill.*

Electric Eyes . . .

. . . of miniature design for use in restricted areas; may be used to operate relays when direct light beam is interrupted or arranged to operate on reflected light; bulletin 590 available on request — *Photomation, Inc., 96 S. Washington Ave., Bergenfield, N.J.*



Valve Operator . . .

. . . provides power-assist in opening and closing iron and steel os & y and non-rising stem gate valves having stem diameters of 2½ in. or less; valves are interchangeable; adaptable for either pneumatic or electric power wrench operation in vertical or horizontal valve installations — *Crane Co., 155 N. Wacker Dr., Chicago 6, Ill.*

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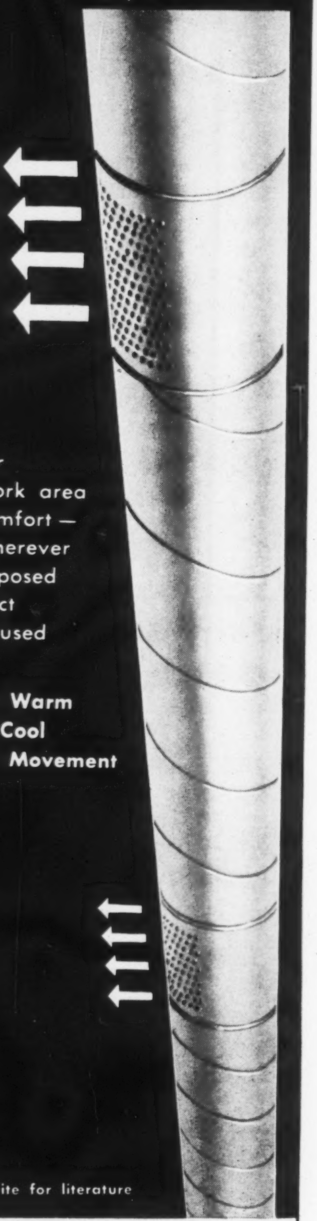
Duct-D-fuser



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work area
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wherever
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duct
is used

for Warm
or Cool
Air Movement

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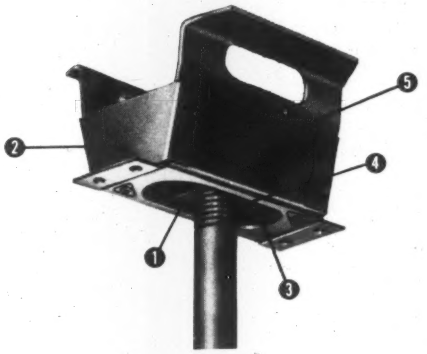
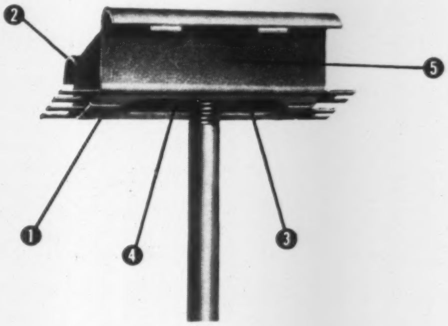
Columbus, Ohio • Stockton, California

See all the extra features you get in Grinnell Concrete Inserts...at no extra cost!



GRINNELL WEDGE TYPE CONCRETE INSERT (Steel), FIG. 281 — 1. Nut and rod may be preassembled for fast installation 2. Wedge-shaped body compresses in concrete for extra strength 3. Knockout (already removed) seals out concrete 4. Full 1¾ inch lateral adjustment 5. Supports up to 1200 lbs.



GRINNELL LIGHT WEIGHT CONCRETE INSERT (Steel), FIG. 285 — 1. Designed for light-duty use in concrete 2 inches and thicker 2. Arched flanges take reinforcing rods 3. Knockout seals out concrete 4. Full 2 inch lateral adjustment 5. Supports up to 400 lbs.

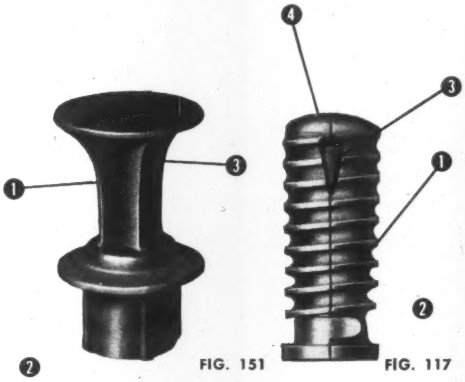
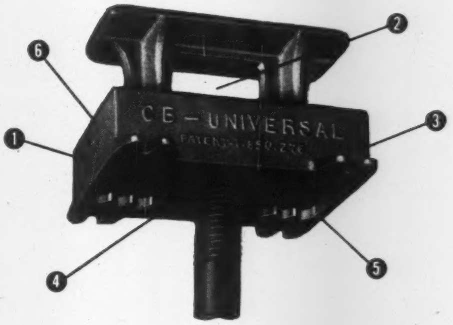


FIG. 151 FIG. 117

GRINNELL SCREW CONCRETE INSERT (Malleable Iron), FIG. 151 — 1. Malleable iron for extra strength 2. Pipe sizes through 12 inches. 3. Supports up to 2,120 lbs. **GRINNELL EXPANSION CASE (Malleable Iron), FIG. 117 —** 1. Malleable iron, cadmium plated, assures high resistance to impact, corrosion 2. Pipe sizes through 16 inches 3. Rod moving upward forces wedge-shaped nut downward, expanding and locking case in concrete 4. Supports up to 1300 lbs.



GRINNELL CB "Closed Back" CONCRETE INSERT (Malleable Iron), FIG. 282 — 1. One body size accommodates 5 sizes of rods 2. Slot takes reinforcing rods to assure maximum load rating. 3. One-piece body prevents concrete seepage 4. Teeth on insert and nut hold rod firmly in place 5. Homogeneous composition of malleable iron throughout 6. Supports up to 1430 lbs. (Also available in smaller "CB-JUNIOR" size that supports up to 770 lbs.)

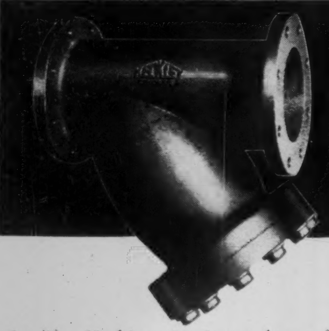
You get *more* for your money from Grinnell, because Grinnell's huge volume reduces production costs . . . lowers prices right into line with competitive inserts offering much less.

Look at all you get with Grinnell Inserts: wider choices of types and sizes . . . better quality control . . . published ratings for *all* inserts! Faster delivery from nationwide warehouses, too. Moreover, you receive dependable field service by trained Grinnell personnel . . . no matter how far from the job site the sale was made! Grinnell Company, 277 West Exchange St., Providence 1, R. I. Branch warehouses in principal cities.

Remember, The Best Costs No More — from America's #1 Supplier of Pipe Hangers and Supports

Call your local Grinnell Distributor for pipe hangers, cast and malleable iron fittings, steel nipples, welding fittings, Grinnell-Saunders Valves, unit heaters – all made by

GRINNELL



Processing, heating and air conditioning FOREIGN MATTER REMOVAL!

Specify Keckley Strainers for safe, sure removal of foreign matter from distribution systems — *ahead* of preheat and re-heat coils, control valves, steam traps, pumps and other equipment.

Assure your next processing, wet heat or air conditioning installation of maximum performance with Keckley Strainers — the best performance insurance you can buy.

Write for your copy of Bulletin 260 showing Keckley's complete line of steam and liquid control equipment.

Y-Type Self-Cleaning Strainers

In 1/4" to 12" pipe sizes in semi-steel bodies to 250 lbs. steam, bronze bodies to 300 lbs. steam, and cast steel bodies to 600 lbs. steam. Screwed or flanged connections. All size perforated brass, stainless steel or monel screens available, as well as wire meshes, for proper media selection.

Basket Type Strainers

For pressure and suction pipe lines. Basket lifts from top, cleans easily. Semi-steel bodies to 250 psi, bronze bodies to 300 psi, and steel bodies to 600 psi. Brass or stainless steel screens. Also available with vertical blow down.

O. C. KECKLEY COMPANY

General Offices and Factory

3400 CLEVELAND ST., SKOKIE, ILLINOIS

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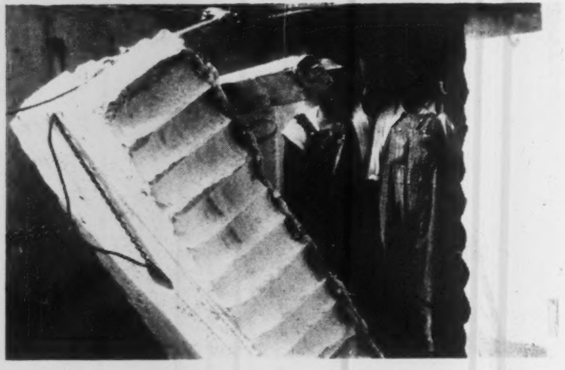
Pressure Regulators • Temperature Regulators • Float Valves
Strainers • Solenoid Valves • Reducing Valves
Pop Safety Valves • Relief Valves

CUTTING POWER!

Doors Through 18-inch Walls



How do you cut doors and windows through *18-inch reinforced concrete walls* without ruinous delays? A general contractor got the job done and out of the way with Longyear diamond drilling equipment. *Workmen cut around the openings with 6-inch diamond bits,* and carefully lifted out the giant slabs of concrete. The whole job was done in a few days at low cost and the entire project was kept on schedule. Your Longyear dealer can show you *other* diamond drilling applications that are cutting construction costs, and tell you about the new industrial diamond drills.

Adv-169

Longyear®

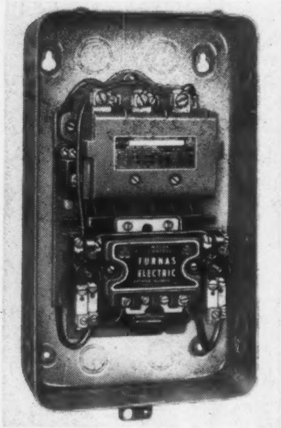
E. J. LONGYEAR CO.
76 S. Eighth Street
Minneapolis 2, Minnesota
Phone: FEderal 9-7631

Please send complete information on Longyear Diamond Bits and Industrial Drills. Also the name of my nearest Longyear dealer.

NAME ____________________
FIRM ____________________
ADDRESS ____________________
TOWN ____________ STATE ____________

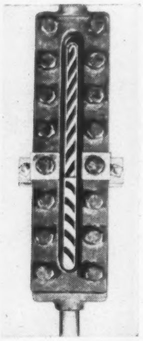
EQUIPMENT DEVELOPMENTS

Continued



Motor Starters . . .

. . . for two, three, or four pole applications; size 2, 10 to 25 hp, size 2-1/2, 15 to 30 hp; dual voltage and frequency coils standard to match 110/220 and 220/440 v dual voltage 50 or 60 cy motor applications; push buttons, selector switches, auxiliary interlocks, pilot lights, and third overload relays available as field kits or installed at factory; bulletin "11-B2" available on request — *Furnas Electric Co., 1000 McKee St., Batavia, Ill.*



Gage Glass Conversion Kit

. . . liquid level kit makes reading possible up to 50 ft away; engineered to show reading at junction of opposing slanted lines within gage glass; equally legible vertical or inclined and fits all standard units; present production for "A7" gages; additional sizes will be available by Nov. 1 — *Windsor Equipment Sales Co., 5 High Court, Little Falls, N.J.*

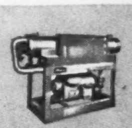
Acme
...the **practical** approach
to air conditioning
Colony
MOTEL
Colony
MOTEL

Architects: A. L. & S. G. Brooks, Atlantic City

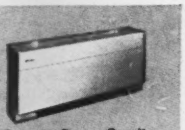
Air conditioning in the summer... ice skating in the winter by Acme

And the beauty of it is that this summer-winter combination does *not* require two separate cooling systems with complicated and costly interconnections, change-overs and controls. Here at the Colony Motel, Atlantic City, the 160-ton Acme installation includes two 60-ton packaged chillers, a 120-ton cooling tower, plus a specially designed "combination" 40-ton chiller with tower. In the summer this entire system is devoted to air conditioning the Colony's 270 units. Come winter, the 40-ton system is simply switched from chilling water for air conditioning to chilling brine for the ice skating rink.

That's the Acme practical approach at work. And how well it works is best testified to by those most directly involved . . . J. P. Hartmann, consulting engineer, Havertown, Pa., who specified the system . . . Benjamin E. Labov & Sons, contractor, Atlantic City, who installed the system . . . Tisch Realty Co., owners of the Colony . . . Acme boosters all. Ask them. Or, if you're more specifically interested in details on this unique Acme dual-purpose package, ask your nearby Acme representative to fill you in. He has the complete story and he'll be happy to work with you. Call him, right now, while you're thinking about it.

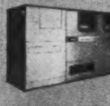


Packaged Chillers, 1½-250 tons



Remote Room Conditioners, 200-600 cfm

Cooling Towers, 3-120 tons



Packaged Air Conditioners, 3-60 tons

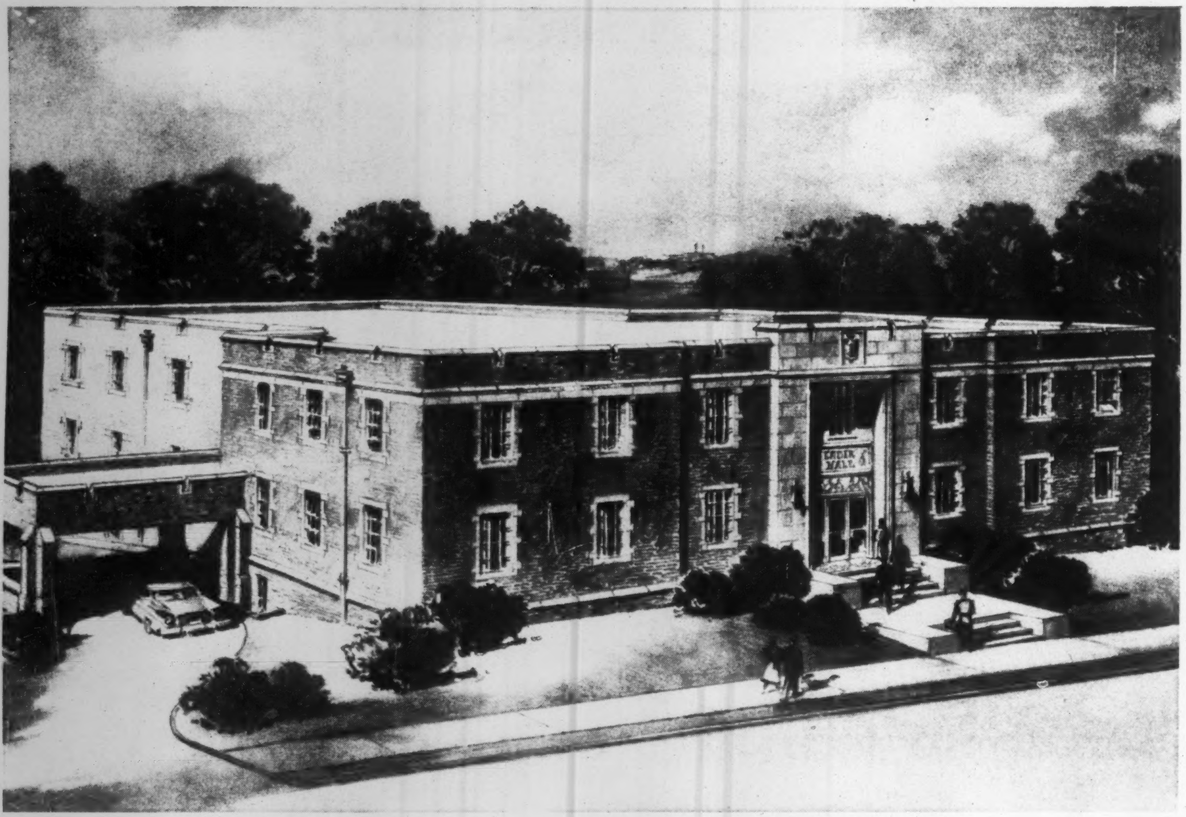
Evaporative Condensers, 10-110 tons

Air Handlers, 665-47,000 cfm

Acme INDUSTRIES, INC.

JACKSON, MICHIGAN

MANUFACTURERS OF QUALITY AIR CONDITIONING AND REFRIGERATION EQUIPMENT SINCE 1919



MARLO *Quietly* LEADS THE CLASS IN ENGINEERS' AIR CONDITIONING TEST

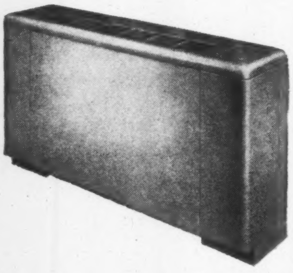
Selected over nine other makes to comfort condition new music conservatory

There was no guesswork in the selection of air conditioning for the new Cadek Hall, conservatory of music at the University of Chattanooga, designed by architects Shepherd and Smith.

The consulting engineers, Campbell & Jones, conducted comparison tests on 10 leading makes of equipment. Judgment was on the basis of noise level, overall construction, and individual features such as access panels, grilles, etc.

Results of the tests pointed conclusively to Marlo Seazonaire remote room units as the best choice. Low noise level in particular was an outstanding characteristic of the Marlo equipment, which operated as quietly at high speeds as other units at low speeds.

For **your** air conditioning needs, you'll find this same high quality typical of the entire Marlo line. The Marlo representative in your area can give you complete information.



Marlo Seazonaire Unit, Model FWC-C, selected for Cadek Hall, University of Chattanooga.

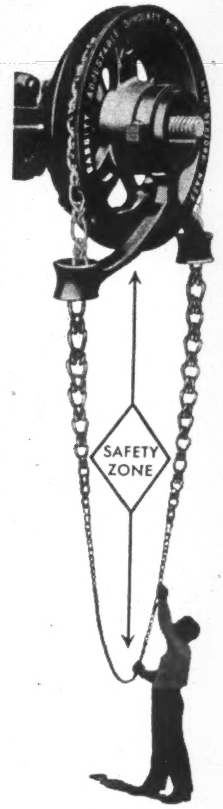
MARLO coil co.

ST. LOUIS 11, MISSOURI

Quality Air Conditioning and Heat Transfer Equipment Since 1925

6007

Babbitt
Adjustable
SPROCKET RIM
with Chain Guide
Changes that Danger Zone to a
SAFETY ZONE



—enables you to ADD PLANT AREA

If re-aligning equipment will yield more working space, better production, lower costs—do it now. Save all space wasted for placing ladders to reach overhead valves. At the same time, convert Danger Zones to Safety Zones. Equip every overhead valve wheel in your plant with Babbitt Adjustable Sprocket Rims with Chain Guides.

- They simplify pipe layout.
- They fit any size valve wheel.
- They are easy to install and operate.
- They operate any valve from the floor.
- They save time and money.
- The first cost is the only cost (no maintenance).
- They are packed completely assembled (one to a carton), with easy-to-follow instructions.
- A hot-galvanized rust proof chain is available for all sizes.

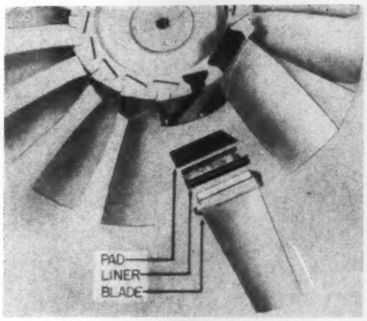
Babbitt Adjustable Sprocket Rims with Chain Guide are carried in stock by most mill supply houses. Just phone your mill supply salesman or contact us direct.

168-9

Babbitt
STEAM SPECIALTY CO.
8 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

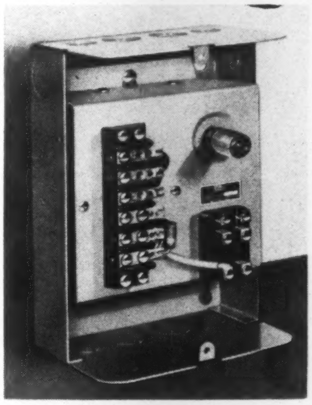
EQUIPMENT DEVELOPMENTS

Continued



Axial Flow Fans . . .

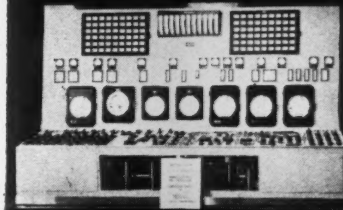
. . . blade retension system allows each individual blade to rotate about its own hub axis to eliminate bending and fatigue stresses; blades individually mounted on rubber pads to permit easy maintenance; installed on in-line connections with existing duct work; can be mounted on walls or ceiling — *Benson Mfg. Co., Commercial Blower Div., Kansas City 27, Mo.*



Liquid Level Control . . .

. . . high sensitivity electronic floatless unit developed primarily for use with liquids of medium to high specific resistance, up to 12.5 mego; low electrode potential of 9 v d-c and current of less than 1 ma eliminate all shock and sparking hazards and contamination due to electrolysis; system can be operated over leased telephone lines or other lead wires with control unit located several miles away from electrodes — *B/W Controller Corp., 2200 E. Maple Rd., Birmingham, Mich.*

WHAT COMES UNDER
ENERGY CONTROL?



On paper it's just a phrase, but at work with you and your company it's important. Everything from fuel savings to calculating nuclear fuel costs comes under the heading of "energy control"—a subject of profit to you and your company.

Constant changes in the field make it imperative that you see such exhibits at the Power Show as temperature controllers, pressure and draft controls, liquid heat controllers and many others —PLUS a broad line of other power and allied equipment.

Only at the Power Show do you have the opportunity to investigate, compare and get the right answers, face-to-face, from the manufacturers themselves. Only at the Power Show can you see over 250 leading suppliers' products, all conveniently grouped together at one time.

Make sure you're there. Everyone else will be!

2523

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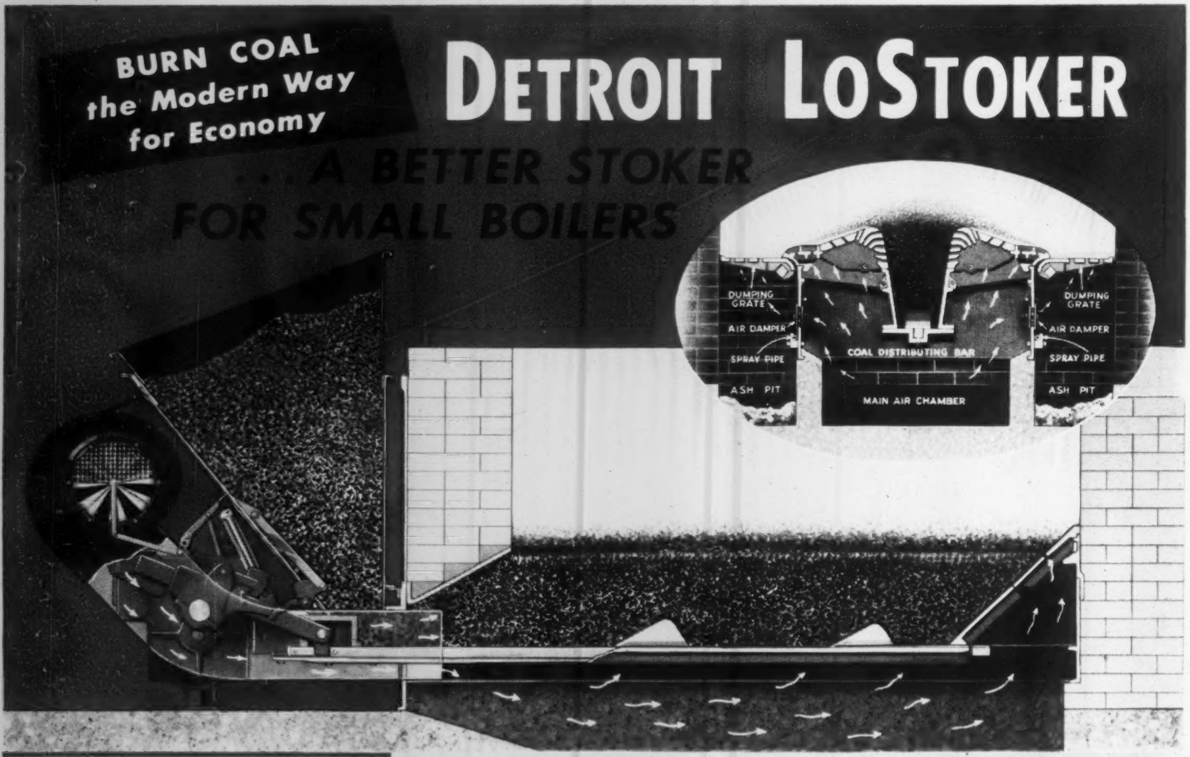
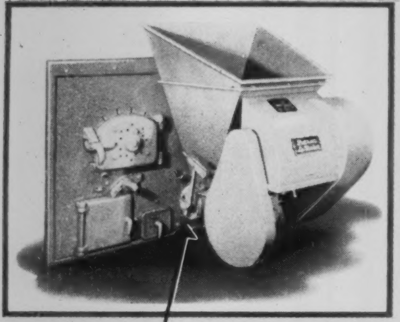
AUSPICES ASME
NEW YORK COLISEUM
NOV. 28—DEC. 2, 1960
MANAGEMENT: INTERNATIONAL EXPOSITION COMPANY
480 Lexington Ave., New York 17, N. Y.

BURN COAL
the Modern Way
for Economy

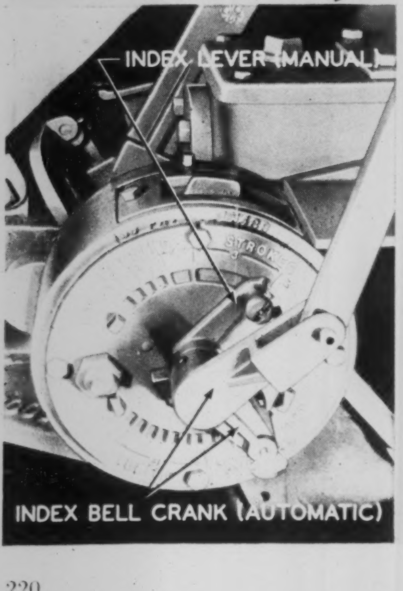
DETROIT LoSTOKER

... A BETTER STOKER FOR SMALL BOILERS





DETROIT ADJUSTABLE FEED



Many Sizes—3,000 to 12,000 pounds steam per hour. Readily applied to new or old boilers. Save coal—eliminate smoke.

The Detroit LoStoker is a plunger type underfeed, mechanically driven, side cleaning stoker sturdily built for long trouble-free service.

LOSTOKER FEATURES INCLUDE:

PLUNGER FEED—Long experience has proved this to be the most dependable type of coal feed.

HEAVY DUTY, MECHANICAL DRIVE—Machine cut worms and gears, mounted in roller bearings, run in oil. Motor or steam turbine operated, requires little power.

HIGH TUYERES—Supply more air toward center of retort, reducing coking tendency, increasing burning rate and improving efficiency.

INTEGRAL FAN—Fan and stoker driven by a single motor or turbine. LoStokers are easy to install.

CONTROL—Thirty-two different coal feeding rates. Optional are "Start and Stop" or "Fully Automatic," with the "Adjustable Coal Feed Control." Air supply in either case is proportioned to coal feed.

BRICKSET or FIREBOX APPLICATIONS

LoStokers may be applied in brick setting to all types of water tube, tubular and firebox boilers. Where Furnace volume permits, a LoStoker may be installed directly in the firebox, without front and sidewall brickwork. LoStokers are only one of several types of our underfeed and overfeed spreader stokers.

Write for recommendations. No obligation.

DETROIT STOKER COMPANY

DIVISION OF UNITED INDUSTRIAL CORPORATION

MAIN OFFICE AND WORKS • MONROE, MICHIGAN

District Offices or Representatives in Principal Cities

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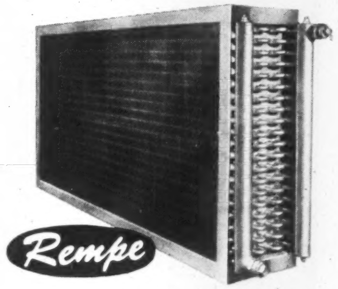
Heat Transfer Equipment

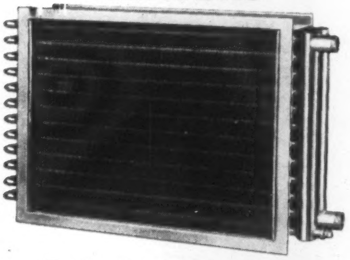
HEATING AND COOLING
FIN COILS



For Air-Conditioning
Heating and Refrigeration

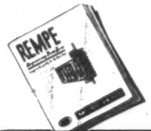
Double headered coils for use with hot water for winter heating or chilled water for summer cooling. Designed for normal or high temperature hot water systems . . . also liquid refrigerants for temperatures as low as minus 200° F. Available in copper or hot galvanized steel.
Any style . . . Any size

STEAM BLEED
HEATERS



For Residential, Commercial
or Industrial Applications

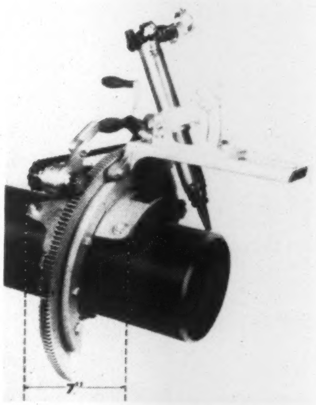
This is the popular Rempe Hi-Cap line of heating coils. Equipped with the exclusive "Defrost-Tap" to keep coil warm during steam off-cycle and prevent freeze-up.
Single or double row designs available . . . any face area desired.
Eight, collared, Aluminum fins per inch on copper tube. Heavy steel casings.



Engineering Data Book
Pipe Coil and Fin Coil Designs. Heat Transfer Coefficients. Get a copy for your library.

REMPE COMPANY
342 N. Sacramento Blvd. • Chicago 12, Ill.

EQUIPMENT DEVELOPMENTS
Continued

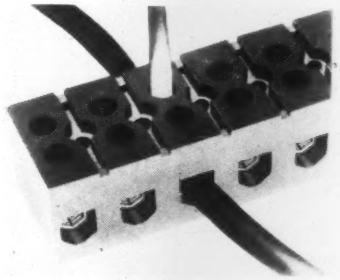


Pipe Beveling Machines . .

. . . features a short, balanced ring gear-saddle assembly, permitting cutting on short segments of pipe; unit is small and light in weight — *C. A. Mathey Machine Works, Inc., 212 S. Frankfort, Tulsa, Okla.*

Protective Paint . . .

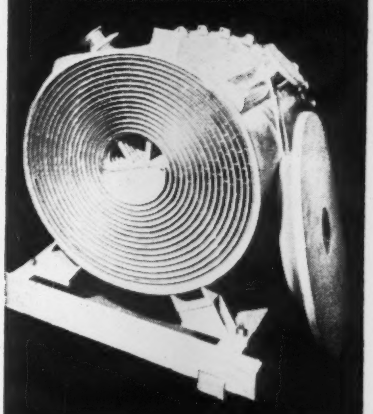
. . . all-purpose black coating designed to protect metal against rust and other exposure conditions; impervious to water and resistant to chemical attack by gas fumes and smoke; anti-corrosive above or below grade; elastic, permitting expansion — *Maintenance Inc., Wooster, O.*



Terminal Blocks . . .

. . . pressure-contact type for heavy duty applications, with molded plastic case; wires are inserted from both sides of block, can be disconnected from either side without disturbing mate; available in any length from 2 to 12 terminals, rated at 85 amp under 8000 v breakdown test — *Kulka Electric Corp., 633-643 S. Fulton Ave., Mount Vernon, N. Y.*

TO BE "HOT" ON
HEAT
TRANSFER



For better answers to questions about heat transfer equipment, how present power-production methods compare with Magneto-HydroDynamics, how greater efficiency than today's 40% can be achieved—visit the Power Show.

The answers are easier, and your job potential better when you've seen the latest in such heat exchanger equipment as condensers, intercharges, feed water heaters, intercoolers, preheaters, after coolers—PLUS a broad line of other power and allied equipment.

Only at the Power Show do you have the opportunity to investigate, compare and get the right answers, face-to-face, from the manufacturers themselves. Only at the Power Show can you see over 250 leading suppliers' products, all conveniently grouped together at one time.

Make sure you're there. Everyone else will be!

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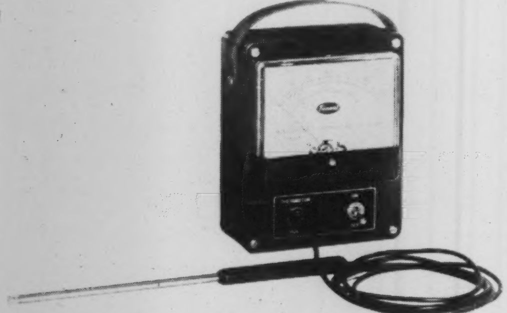
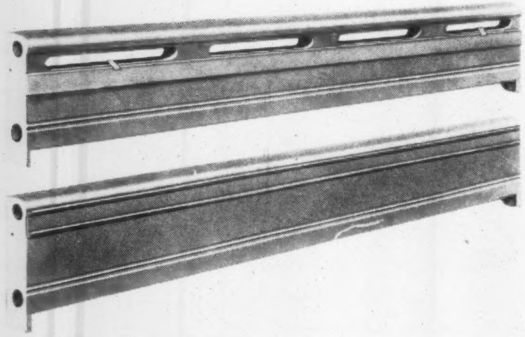


Portable Temperature Indicator . . .

. . . two lb unit has thermistor sensing probes and long life batteries; probes are interchangeable for air, liquid, and surface temperature sensing; available in 10 ranges from −30 to 350 F — *Fenwal Inc., Pleasant St., Ashland, Mass.*

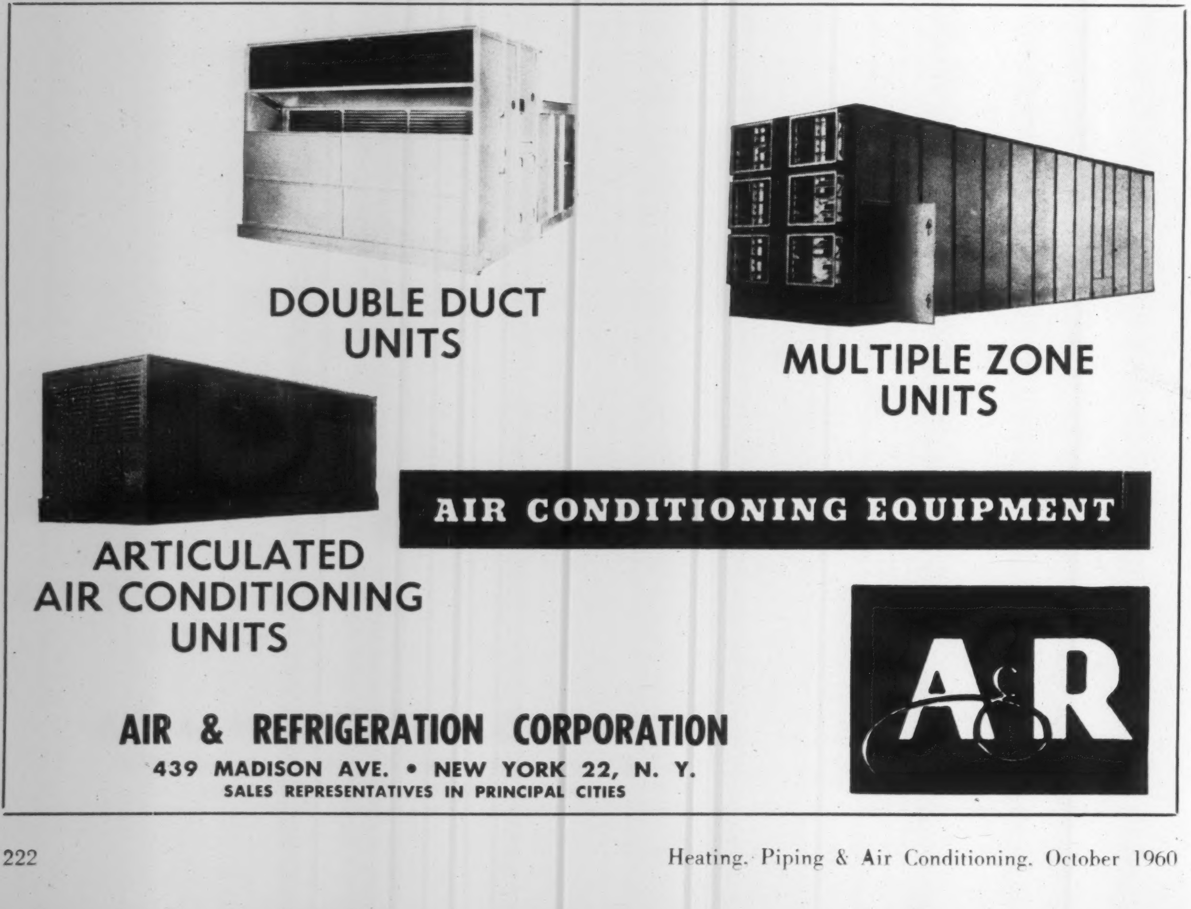
Welding Power Sources . . .

. . . for use with manual and automatic gas-shielded metal-arc welding equipment; provides constant arc voltage output, or varying degrees of down slope; two units rated at 300 amp and 500 amp, both 100 percent duty cycle; 300 amp model is of vertical design; 500 amp model, horizontal — *Air Reduction Sales Co., Div. of Air Reduction Co., Inc., 150 E. 42nd St., New York 17, N.Y.*



Baseboard Dampers . . .

. . . for baseboard radiation units for series loop installations; made of heavy gage steel; designed to fit firm's models, dampers are available in 4, 5, 6, 7, and 8 ft lengths — *Burnham Corp., Heating & Cooling Div., Main St., Irvington, N.Y.*



DOUBLE DUCT UNITS

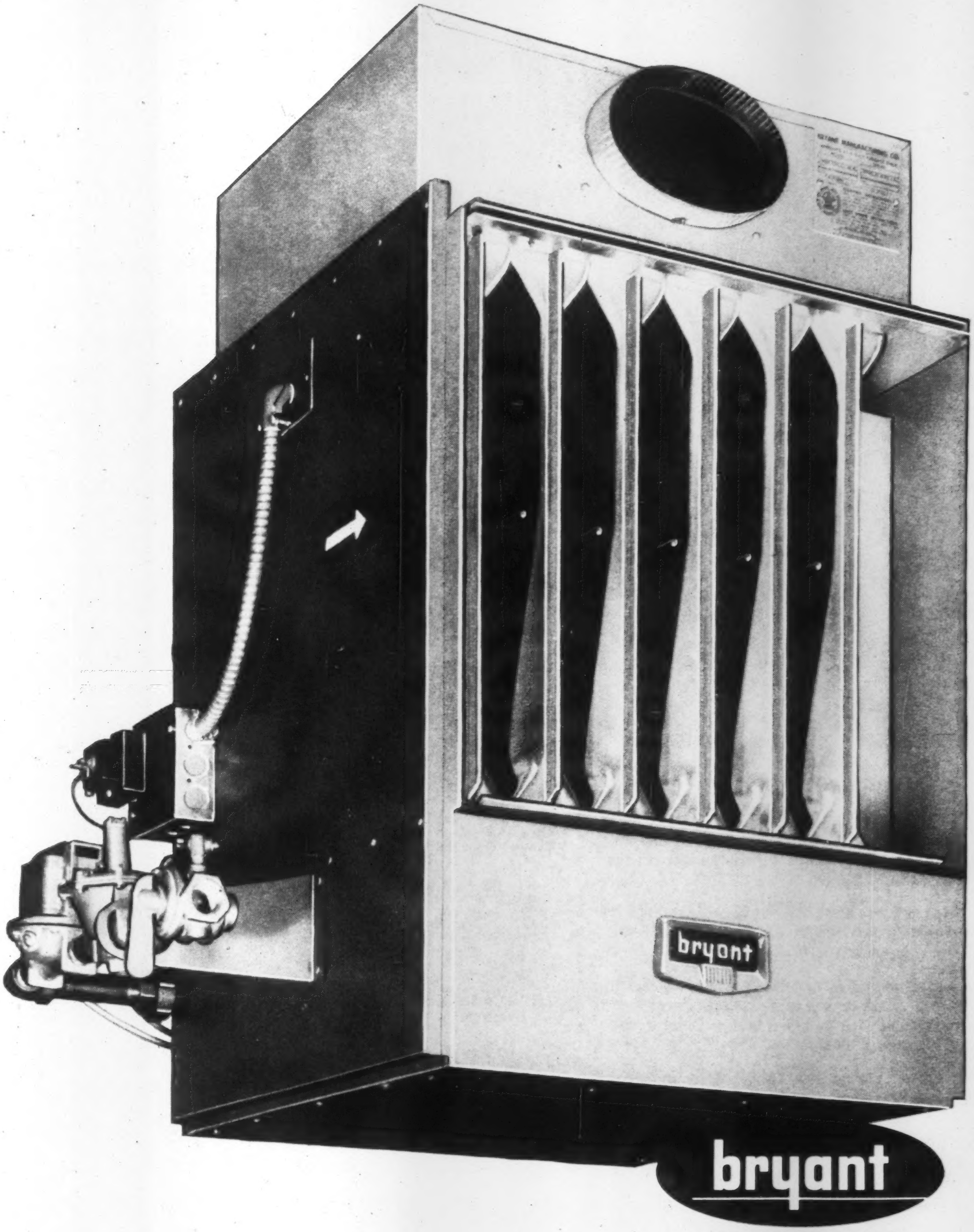
MULTIPLE ZONE UNITS

ARTICULATED AIR CONDITIONING UNITS

AIR CONDITIONING EQUIPMENT

A&R

AIR & REFRIGERATION CORPORATION
439 MADISON AVE. • NEW YORK 22, N. Y.
SALES REPRESENTATIVES IN PRINCIPAL CITIES



bryant

DUCT HEATERS

NEW
FROM BRYANT
GAS-FIRED DUCT HEATER LINE

COMPLETE LINE. 7 sizes—50,000 to 200,000 Btu/hr., in increments of 25,000 Btu/hr. Twinning the units provides capacities up to 400,000 Btu/hr. **FULL LINE OF BLOWER PACKAGES.** Open and closed types suitable for heating and air conditioning. **CONTROLS.** Exclusive valve and pilot can be mounted on either side. **SLIP JOINT DUCT CONNECTIONS.** Guide holes in flanges speed up fastening. **SERVICE IT FROM REAR.** No more bottom servicing. **TRI-ALLOY HEAT EXCHANGER.** Provides faster heat transfer, minimizes noise and resistance to air flow. Three-way protection against high temperatures, corrosion and condensation. **DRAFT HOOD** can be reversed to facilitate flue connection. For complete product information call your local Bryant Distributor or Factory Branch, or write Bryant Manufacturing Co., Indianapolis, Indiana.

HOW TO SAVE 80% PIPE HANGING TIME!

"AUTO-GRIP"
JOB-DESIGNED
BY INDUSTRIAL
ENGINEERS
FOR TOP UTILITY...
MINIMUM PARTS...
NO WASTE MOTION!

★ Fits all ½" to 8" metal or plastic pipe

★ Listed by Underwriters' Laboratories, Inc., Approved by Factory Mutual Laboratory

★ Self-locking, compact, attractive

★ Safe load exceeds rating for standard types—safety factor 5:1

"AUTO-GRIP" was designed by "Automatic" Sprinkler Corporation industrial engineers for their own use as piping installation contractors. "AUTO-GRIP" ease, simplicity, speed and economy soon established it in the trade as the top improvement in pipe hanging efficiency in 50 years!

LOWER INITIAL COST—competitive with least expensive outmoded, cumbersome rings, bands and clevises.

SMALLER INVENTORY—universal adaptability permits quantity buying of fewer types—less storage space.

SAFER—MORE ATTRACTIVE—self-locking via spring tension and pipe weight... shipped assembled, stays assembled... zinc-coated or copper-plated.

REDUCES LABOR COSTS—tests by industrial engineers reveal that "AUTO-GRIP" installs in only 20% of the time required for old-fashioned clevis-type rings. Universal, counterbored hanger insert secures quickly to ceiling hanger rod. Insert is adjusted easily on rod by finger strength.

HOW "AUTO-GRIP" WORKS

Squeeze together —insert drops out

Spread and slip over pipe

Squeeze—replace insert

FREE SAMPLE • TIME-SAVING DATA • MAIL COUPON TODAY!

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COMPANY________________
ADDRESS________________
CITY____________ ZONE____ STATE________
#160

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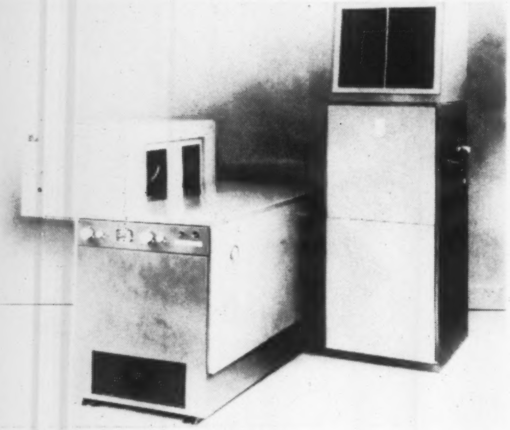
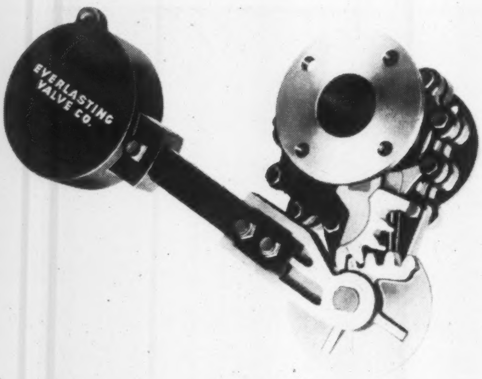
"Auto-Grip" Division
Box 360 • Youngstown 1, Ohio
"Automatic" Sprinkler CORPORATION OF AMERICA



Two-Stage Air Conditioner . . .

. . . consists of single dual-circuited condenser with twin hermetic compressors, applicable for use with separate air handling units in adjoining spaces or for step-starting under conditions of varying peak loads; total cooling capacity is 9 tons, compressors are equipped with separate controls and indicators; horizontal and vertical discharge units available, optional accessories include low-ambient temperature head pressure control system and water dump-and-fill system —*Rheem Mfg. Co.,* 400 *Park Ave., New York* 22, *N.Y.*

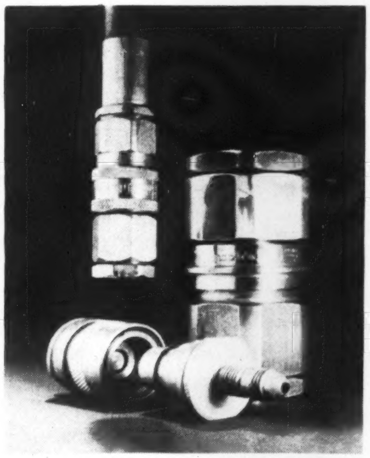


Eccentric Valve Gearing . . .

. . . designed for use in conjunction with firm's pendulum-stop valve provides emergency protection on fire mains and hazardous liquid lines, uses direct gear action to open or close disc-type gate valve by employing torque developed by free swinging weight at end of lever arm; gears automatically disengage at end of swing to prevent valve damage, remesh when valve is reset; for valve sizes from 1 to 8 in., flanged or screwed types; unit is available in variety of materials—*Everlasting Valve Co.,* 49 *Fisk St., Jersey City* 5, *N.J.*

EQUIPMENT DEVELOPMENTS

Continued



Pipe Couplings . . .

. . . quick-disconnect units with electroless nickel plating to protect against corrosion; no void between coating and base metal — *Snap-Tite, Inc.,* 201 *Titusville Rd., Union City, Pa.*

Circuit Breakers . . .

. . . thermal-magnetic unit will carry up to 225 amp, has interchangeable trip and will interrupt up to 30,000 amp at 240 v a-c; width 5½ in., length 10⅛ in.; five other sizes available with ratings from 10 to 800 amp, with interrupting capacities from 5000 to 50,000 amp; all are rated at 600 v except one that is rated at 240 or 277 v — *Westinghouse Electric Corp., P.O. Box* 2099, *Pittsburgh* 30, *Pa.*

THE NEWEST ADDITION TO THE
Havens FAMILY

Centrifugal Blower Fan
Cooling Tower Series

C. B. C. Series are 10 to 150 ton rugged towers featuring access panels for quick and easy inspection.

SHIPPED ASSEMBLED . . . . . . BUILT TO LAST

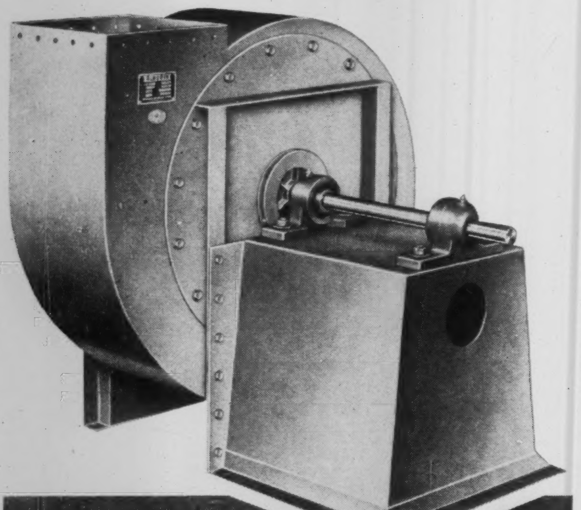
- All Steel parts are hot dip galvanized after fabrication.
- Quieter Operation.
- Centrifugal blower fan
- All select heart Redwood fill.

HAVENS assures you quality, performance and minimum maintenance in every Tower—

Write for New Free Bulletin

Havens COOLING TOWERS
Division of
HAVENS STRUCTURAL STEEL COMPANY
1713 Crystal Avenue Kansas City 26, Missouri

Aladdin
AIR HANDLING EQUIPMENT



TYPE
"EX"
INDUSTRIAL
EXHAUSTER

- RUGGED
- EFFICIENT
- DEPENDABLE

ALADDIN Industrial Exhaust Fans are all-welded steel plate construction. They are ideal for material handling such as conveying grains, shavings and sawdust, or for dust removal from grinding of buffing wheels. The EX fan is also the first choice for many jobs where fumes, hot air or gasses must be handled by a rugged, efficient, dependable fan.

Write for complete data 5

ALADDIN HEATING CORPORATION
1111 WEST AVENUE 137 • SAN LEANDRO, CALIFORNIA

RECENT TRADE LITERATURE...

▶ *AIR CONDITIONING CONTROLS* — includes line of coded control, fan, system, and cooling centers; automatic changeover control for use on heating-cooling fan coil units; all-range water valves shown from 3/8 through 1½ in. sizes; Bulletin "1487-AN." *Penn Controls, Inc., Goshen, Ind.*

▶ *AIR DIFFUSERS* — 12 page bulletin illustrates and describes firm's new line offered in three different series; gives dimensional drawings of the several diffuser types in each series plus complete selection and performance data. Bulletin "K-27A." *Connor Engineering Corp., Dept. K-D, Danbury, Conn.*

▶ *AIR SAMPLER* — bulletin contains literature concerning battery powered, lightweight, portable unit; table of various filter papers used for sample collection including primary uses of each type and their composition; illustrations and prices for both in-line and open filter holders; model specifications for two of firm's samplers with built-in battery chargers. *Gelman Instrument Co., 106 N. Main St., Chelsea, Mich.*

▶ *ALUMINUM GRILLES* — 20 page bulletin includes dimension data, return air chart, size selection table, pressure ratings, sound ratings and suggested wall installation details; Extruded units available in five standard flat and beveled margin designs; grille bars can be furnished set straight, or deflected 15 or 30 deg; pencil-proof bars also available. *Tuttle & Bailey, Div of Allied Thermal Corp., 215 Warren St., New Britain, Conn.*

▶ *BI-DIRECTIONAL WINDVANE* — for detailed studies of wind direction both in azimuth and elevation angles simultaneously; pamphlet also includes description of dual-rectilinear recorder for receiving potentiometer-varied current from power supply. *Gelman Instrument Co., 106 N. Main St., Chelsea, Mich.*

▶ *BOILER SERVICE GUIDE* — revised pocket size guide gives details on servicing firm's boiler water feeders, low water cut-offs, and feeder cut-off combinations; also gives right and wrong piping hook-ups, and facts about trouble shooting; section covering replacements is included. *McDonnell & Miller, Inc., 3500 N. Spaulding Ave., Chicago 18, Ill.*

▶ *COMBINATION AIR-LIGHTING UNITS* — multipurpose units provide illumination, cool air, and warm

RECENT TRADE LITERATURE *Continued*

air from the same concealed ceiling fixtures; 44 page catalog includes detailed illustrations and specifications and describes how air is distributed in a low velocity, even flow, draft-free manner. Bulletin "B." *Thomas Industries Inc., Advertising Dept., Benjamin Div., 207 E. Broadway, Louisville, Ky.*

▶ *DUCT SILENCERS* — circular units built in normal and low pressure drop versions described in four page bulletin with pressure drop vs airflow charts for standard models; noise reduction values also given. Bulletin "B10." *Silence, Inc., P.O. Box 21, Farmingdale, N.Y.*

▶ *ELECTRIC MOTOR CONTROLS* — 56 page, pocket catalog includes descriptions, ratings, and prices for manual and magnetic starters, drum controllers, pressure, foot, and limit switches; push buttons and related pilot devices also described. *Furnas Electric Co., 1041 McKee St., Batavia, Ill.*

▶ *ELECTRIC MOTORS* — 14 page condensed catalog with data for designing, selecting and specifying; gives construction, dimension and price data on firm's line of fractional and integral horsepower motors; describes many motor modifications available; illustrates special designs of varied types. *Doerr Electric Corp., 100 N. Fourth Ave., Cedarburg, Wis.*

▶ *ESTIMATING CATALOG* — covers over 80 percent of products used in air conditioning, heating, ventilating, and refrigeration, firm claims. Forty page catalog includes blower units, fans, coils, cooling towers, evaporative condensers, valves, fittings, etc.; illustrations, selection tables, pricing tables, and packaged roof air conditioning units in sizes from 3 to 30 tons also included. *Blazer Corp., 173 Market St., Passaic, N.J.*

▶ *FLOW INDICATOR* — for purge service or flow rate indication at elevated pressures. Bulletin "#132" describes flow rate measurements meters designed to operate at pressures up to 1500 psig; unit available in ½, 1, & 1½ in. sizes to handle flow in ranges from a minimum of 1.5 gph to 50 gpm. *Brooks Instrument Co., Hatfield, Pa.*

▶ *GAS HEATERS* — catalog features LP units and includes salamanders, infrared, and blower heaters as well as accessories such as cylinder carts, auxiliary blowers, heating torches, and malting furnaces. *Insto-Gas Corp., 998 E. Woodbridge, Detroit 7, Mich.*

▶ *GAS WELDING REGULATORS* — for use with all industrial gases; portable manifolds for use with oxygen and acetylene; sixteen page catalog includes complete specifications and ordering information, recommended uses, and typical installations for each regulator described; describes line of single-stage regulators

Manufacturers' Agents

Are you interested in securing additional lines?

We are occasionally asked by our manufacturer advertisers to suggest the names of manufacturers' agents in various sections of the country whom they can contact in regard to representation of their industrial heating, piping and air conditioning products.

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Heating, Piping & Air Conditioning

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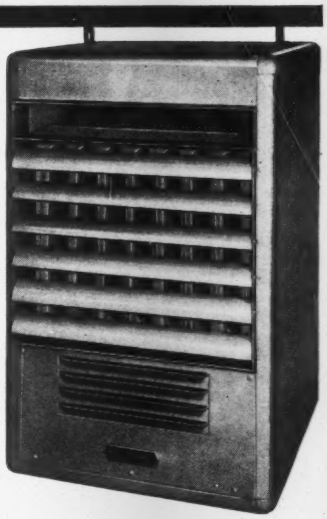
TOP ECONOMY, EFFICIENCY

MUELLER CLIMATROL
Gas Suspended Unit Heater



- Complete size range from 25,000 to 225,000 BTU/hr.
- Efficient, safe, all-welded, tubular-design heat exchanger
- Quality, trouble-free, cast-iron drilled-port burner
- Convenient triple-duty lifting and hanging brackets
- Automatic fan and limit control plus summer switch
- AGA approved for Natural, Mixed, Mfd., Propane gas
- Shipped assembled, pre-wired, and test fired.

Write for free information today.

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DIVISION OF WORTHINGTON

2000 W. Oklahoma Ave. Milwaukee 1, Wis.
1024 Westminster Ave. Alhambra, Calif.

THE COMPLETE LINE FOR INDOOR CLIMATE CONTROL

MC-44

RECENT TRADE LITERATURE

Continued

without gages; "Form 55-085." *Linde Co., Div. of Union Carbide Corp., 270 Park Ave., New York 17, N.Y.*

▶ *HEAT EXCHANGER* — brochure describes unit designed to recover heat from contaminated exhaust air or cool incoming outside air into refrigerated spaces. *Heat Recovery Corp., 671 Mt. Prospect Ave., Newark 4, N.J.*

▶ *HEATING CALCULATOR* — to determine number and size of heating units needed for a given area; calculator is in slide rule form, made of heavy paper stock; gives typical heat loss calculations. *The Wanson Corp., Charles & Juniata Sts., Lewistown, Pa.*

▶ *HINGED CLOSURE* — revised bulletin "TT956" dimensional data covers closures produced in carbon steel in sizes from 2 through 42 in.; extension of 300 and 600 lb series includes counter-balanced, spring-loaded closures for verticle service; extension of 150 lb series includes sizes under 18 in.; applications are outlined for blanking off pipe-line ends and tank or vessel openings. *Tube Turns Div., Chemetron Corp., Louisville 1, Ky.*

▶ *LEAK DETECTOR* — 10 page bulletin discusses methods for finding refrigerant leaks down to ½ oz a year, and for quantitative measurement of leaks; description and prices of three models, plus accessories. Bulletin "GEA-6827A." *General Electric Co., Schenectady 5, N.Y.*

▶ *MIXING BOXES* — acoustical terminal control units for all-air, high velocity systems described in 36 page catalog. Provides information and specifications on three ceiling models and two window/perimeter models; contains engineering data on system noise and new tables of static-pressure losses and regains. Catalog No. "1060." *Carnes Corp., Verona, Wis.*

▶ *MOTOR OPERATED VALVES* — 16 page, two color bulletin "100" discusses design, operation, and typical application of units; units feature an interchangeability of parts, induction type motor, stainless steel valve stem, and heavy construction valve bodies. *Warren Engineering Co., Div. of Warren Automatic Controls Corp., Route 24, Broadway, N.J.*

▶ *MOTORS* — selection guide in form of a 3 x 7 in. card provides quick reference to frame size (182 to 445U) and book price for a-c motors from ¾ to 125 hp; data tabulated for both dripproof and totally enclosed fan-cooled squirrel cage, horizontal motors; units are three phase, 60 cycle, for 208-220/440 or 550 v; bulletin "GED-3909A." *General Electric Co., Schenectady 5, N.Y.*

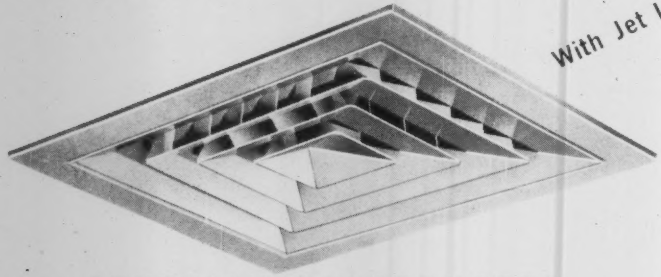
▶ *PACKAGE CONTROL SETS* — designed for temperature control of all valve-type classroom unit ventilators; brochure "F-9754" describes features such as electronic sensing, motor operators with integral thermo-

THE ORIGINAL SQUARE AND RECTANGULAR AIR DIFFUSERS

AGITAIR®

GENUINE PRODUCTS

With Jet Induction Diffusing Vanes



STURDILY CONSTRUCTED

- All louvers are firmly welded to diffusing vanes in parallel lines.
- The louvers cannot be tampered with or altered.
- Solid construction eliminates strumming or vibration.
- A metal plate is welded at the corner joints to add greater rigidity to the unit.

MORE THAN 1,000,000 IN USE TO-DAY

Only AGITAIR square and rectangular diffusers employ the jet induction feature due to scientically designed diffusing vanes.

These AGITAIR diffusers with built-in diffusing vanes, are designed and positioned to serve as air pumps, compressing the air into a multiplicity of jets. These jets issuing from spaces between adjacent louvers, produce a high degree of turbulence which rapidly mixes the primary and room air and assures control of the entire cubicle contents of the spaces served.

AGITAIR jet induction type diffusers are custom-made with louver arrangements for 1-2-3 or 4 way proportional blows.

Ask for technical catalog R-108

AIR DEVICES INC.

185 MADISON AVENUE, NEW YORK 16, N.Y.

BETTER PRODUCTS FOR

AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST

RECENT TRADE LITERATURE

Continued

stats, and plug-in control, and power wiring. *Barber-Colman Co., 1701 Rock St., Rockford, Ill.*

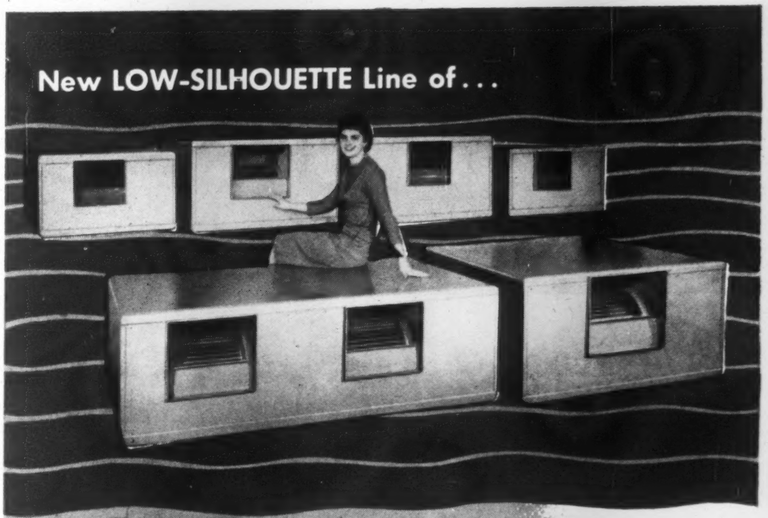
▶ *PACKAGED CHIMNEYS* — illustrated, fold-out brochure gives details on the principle and construction of firm's chimneys; includes model illustrations, a chart of model combinations, and cut-away diagrams showing assembly and operation. *General Products Co., Inc., Fredericksburg, Va.*

▶ *PLASTIC TUBE* — up to 36 in. diameter described in literature containing tables and descriptive matter on chemical, electrical, and mechanical properties of firm's product; stock list with standard dimensions and tabulation of weights and tolerances also included; other shapes of product given. *Fluoro-Plastics, Inc., 2417-X25 Federal St., Philadelphia 46, Pa.*

▶ *PNEUMATIC PUMPS* — for materials such as oils, molasses, brine, paints, acids, and molten salts. Four page "bulletin 4601" includes selection data, air requirement charts, new float operated control valve option, detailed installation diagrams, and descriptions of lead-lined stoneware, rubber-lined, cast-iron horizontal units. *Yeomans Brothers Co., 1999 N. Ruby St., Melrose Park, Ill.*

▶ *PUMPING DATA* — cost of electrical pumping and methods for testing pumps are two of many subjects contained in a 20 page manual. "Useful Pumping and Hydraulic Engineering Data." Mechanical and electrical equivalents, a pipe friction loss chart, a Weir table, and orifice charts of pipe also given. Bulletin "EM-77." *Peerless Pump Hydrodynamics Div., Food Machinery and Chemical Corp., 301 West Ave. 26, Los Angeles 31, Calif.*

▶ *PUMP MOTORS* — brochure consists of collection of technical articles. Illustrated with charts, diagrams, graphs, tables, and cutaways dealing with the following subjects: "What



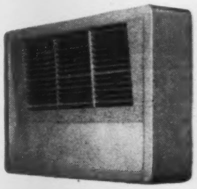
BOHN YEAR-ROUND AIR CONDITIONING UNITS

In 6 ULTRA-COMPACT Models

Quiet, compact and low in cost, Bohn's new CH line of air conditioning units is engineered to provide maximum efficiency in minimum space for cooling and heating stores, offices, restaurants, apartments and shops. There are six attractive models from 2 through 15 ton capacities. Each features a heavy gauge bonderized steel cabinet with discharge plenum* finished in durable gray hammertone enamel and trimly styled to blend into almost any decor.

Units can be set up for either cooling or heating, easily converted to year-round air conditioning at a later date . . . and when desired can be remotely mounted and connected to a duct system. Ease in inspection and maintenance is assured by convenient sectional panel design. Trouble-free operation is provided in standard, open 1725 rpm motors (the drip-proof type with resilient base, adjustable mounting and variable pitch pulley). Write for complete details today.

*Modern discharge plenum with double deflection grille and the fixed inlet grille are both offered as optional accessories.

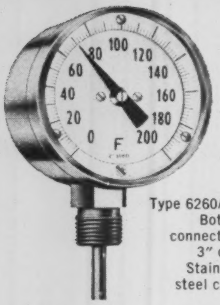


BOHN *Buy the known line . . . the BOHN line*
ALUMINUM & BRASS CORPORATION
Danville Division • Danville, Illinois

[illegible]

TEMPERATURE MEASUREMENT

AMERICAN THERMOMETERS DO THE JOB *ACCURATELY*



Type 6260AH—Bottom connection. 3″ dial. Stainless steel case.

They respond quickly and accurately to all temperature changes, whether mounted on a blower in a basement or on air conditioning equipment on a roof. American Bi-Metal Dial Thermometers combine superior resistance to vibration with the greatest sensitivity in bi-metal actuation. Two other advantages provide extra value:

ANTI-PARALLAX MAXIVISION® DIAL guarantees surest, sharpest, easiest readings. It is a split-level dial constructed with graduations and pointer on the same plane. No perspective effect. No parallax error in reading. Only American Thermometers have this feature.

WEATHERPROOF CONSTRUCTION seals out all atmospheric and application conditions that might cause erosion, corrosion, inaccuracy and shorten service life.

Wherever accurate temperature measurements are essential—whatever the operational temperatures of the heating or air conditioning system — choose American Thermometers. Mounting styles include the "Every Angle" thermometer you can set for face-to-face readings wherever installed. Dial sizes, temperature ranges and stem lengths to meet your needs exactly. *Write for Catalog 100.*

Type 6360AH — Back connection. 3″ and 5″ dials. Stainless steel case.

Type 6060AH—"Every Angle" connection permits setting at any point within 180° on two axes. 5″ dial. Stainless steel case.

Type 6360AH — Back connection. 2″ dial permits installation in close quarters without sacrificing readability. Stainless steel case.

AMERICAN THERMOMETERS

A product of

MANNING, MAXWELL & MOORE, INC.

Gauge and Instrument Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

RECENT TRADE LITERATURE

Continued

You Should Know about Turbine Pump Motor Lubricants," "Facts about Pump Motor Bearings," "The Why and How of Pump Motor Protection," and "Pumping Stations and Sound Control." *U.S. Electrical Motors Inc., P.O. Box 2058 Terminal Annex, Los Angeles 54, Calif.*

▶ *RADIANT HEATERS* — leaflet describes new line for use as a central-core or auxiliary heating system; details in chart form, total watts, volts, amps, size, coverage, and watt density per sq ft for the 10 models and three sizes comprising line. *Apextro Products Co., 1821 N. Eastlake Ave., Los Angeles 31, Calif.*

▶ *REGISTERS, GRILLES, DIFFUSERS* — four color, 72 page catalog includes unit illustrations, specifications, capacities, selection charts, dimensions, installation diagrams and instructions, and price list. Firm's line of self drilling and sheet metal screws also described. Catalog No. "60-AC." *Leigh Building Products Div., Air Control Products, Inc., Coopersville, Mich.*

▶ *SCALE REMOVER* — liquid concentrate removes scale, slime, and algae on air conditioning systems; also reduces head pressure; non-toxic, contains no hydrochloric or other fuming acids; does not corrode copper, brass, aluminum, or steel and will not attack wooden or painted towers. Described in bulletin from *Lester Laboratories, Inc., P.O. Box 4897, Atlanta 2, Ga.*

▶ *SOLID LUBRICANTS* — theory and practice of lubrication by solids explained in 24 page, four color booklet; discusses boundary friction and role of molybdenum disulfide lubricants in reducing friction and wear under heavy loads and at high temperatures; lists product available in powder form, as greases, resin bonded coatings, dispersions, and other special forms. Bulletin "124." *The Alpha-Molykote Corp., 65 Harvard Ave., Stamford, Conn.*

▶ *SPEED REDUCERS* — brochure No. "F-2003" includes tables showing three service classifications with frame size selection tables for each classification; high and low gear ratios for each horsepower and frame size, with preferred ratios for specific motor rpm's indicated; dimension drawings and tables, hollow shaft bushing diameters, and illustrations of typical applications. *U. S. Electrical Motors Inc., P. O. Box 2058 Terminal Annex, Los Angeles 54, Calif.*

RECENT TRADE LITERATURE

Continued

▶ *SPRING MOUNTS* — for high impact shock and large deflections; units feature isolation efficiency for both vibration and shock, adjustable damping, and built-in leveling adjustment; five sizes, each with four individual load ratings described in bulletin "60-04.2." *Barry Controls, Inc., 700 Pleasant St., Watertown 72, Mass.*

▶ *STARTERS AND STARTER-GENERATORS* — catalog file covering all standard and custom units; includes full line of 75, 100, 200, and 400 amp starter generators as well as direct cranking electric starters; specifications, drawings, and performance curves are illustrated. *Breeze Corporations, Inc., 700 Liberty Ave., Union, N.J.*

▶ *SUBMERSIBLE MOTORS* — designed for operation in low head pumping, motors are offered in a range from ¾ to 40 hp; design features are brought out with a full cross-section drawing and with detail drawings and diagrams in "bulletin No. "F-1976." *U. S. Electrical Motors Inc., Box 2058 Terminal Annex, Los Angeles 54, Calif.*

▶ *THERMOCOUPLE WIRE* — catalog contains 12 pages of information on both thermocouple and extension wire, bare and insulated. Catalog "C-100-2." *Minneapolis-Honeywell Regulator Co., Wayne and Windrim Avenues, Philadelphia 44, Pa.*

▶ *UNDERGROUND PIPE INSULATION* — for thermal insulation of hot or cold permanent underground pipes; installation consists of packaging a dry, granulated, resinous hydrocarbon of petroleum origin around pipes; five page technical bulletin includes data on physical properties of various grades of product; quick reference tables for determining grade required and amount needed; recommended installations also given. *Witco Chemical Co., Inc., 122 E. 42nd St., New York 17, N.Y.*

▶ *UNIT VENTILATOR* — for schoolroom heating, cooling, and ventilating; described in a four color, 14 page brochure that features a foldout spread illustrating unit's operation through an exploded view of its components; product features, engineering information, and ratings also given. *Warren Webster & Co., 17th and Federal Streets, Camden 5, N.J.*

Heating and Air Conditioning

PRESSURE

MEASUREMENT

ASHCROFT GAUGES DO THE JOB *ACCURATELY*

Ashcroft Duragauge in Phenol. Case

Name the operational pressures of any heating, piping or air conditioning equipment you specify, install or service: There's an Ashcroft Gauge to measure the pressures precisely—from 30″ vacuum or a few ounces to the highest psi used on any system. That is why Ashcroft Gauges are used on everything from giant boilers to small compressors.

You have a choice of three classes of Ashcroft Gauges. Each class has functional characteristics compatible with its recommended applications.

DURAGAUGES: The finest pressure gauges you can specify and install on any heating, piping or air conditioning system. Highest sustained accuracy and durability assure savings in replacements and repairs far exceeding the initial investment.

QUALITY GAUGES: Second only to the Duragauge in ruggedness and sustained accuracy. Ideal for the normal industrial, commercial and institutional equipment.

STAINLESS STEEL CASE GAUGES: The best gauges for small compressors, pumps, boilers and the less important pressure lines. Inexpensive but accurate and durable.

Whatever the medium under pressure—air, oil, water, steam, or refrigerant—select Ashcroft Gauges. Pressure, vacuum and compound ranges available. Several dial sizes. *Write for Catalog 300B.*

Ashcroft Quality Gauge in Alumalife® Case. Catalog No. 1010.

Ashcroft Gauge in Stainless Steel Case. Catalog No. 1000.

ASHCROFT PRESSURE GAUGES

A product of

MANNING, MAXWELL & MOORE, INC.

Gauge and Instrument Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

RECENT TRADE LITERATURE

Continued

▶ *WATER-COOLED CONDENSERS* — for refrigeration and air conditioning systems where minimum space is available; sizes covered range from 1/3 to 25 tons in standard, heavy duty "R" series close-coupled, "WR" series multi-section, and "SW" series to operate on sea water or under corrosive conditions; charts showing water consumption and pressure drops for the various models also included. Eight page bulletin "WC-300" available from *Halstead & Mitchell Co., Bessemer Building, Pittsburgh 22, Pa.*

▶ *WATER HEATERS* — booklet lists some of the installations of firm's tankless units. Water heaters feature twin tankless coils, two temperature hot water, and a range of sizes from the smallest demand up to 300 to 6000 gph at 100 F rise. *Portmar Water Heater Co., Inc., 193 Seventh St., Brooklyn 15, N.Y.*

▶ *WATER TREATMENT* — booklet entitled "Instrumentation for Treatment of Industrial Water" describes typical water treating systems used in the processing industries, and explains how instrumentation has been applied to these systems. Bulletin "B96-2." *Minneapolis-Honyewell Regulator Co., Industrial Div., Wayne and Windrim Avenues, Philadelphia 44, Pa.*

▶ *WATER TREATMENT* — comprehensive method for treating and protecting recirculating water equipment and process water systems is covered in four page brochure; additive used is said to present no waste disposal problems because its ingredients are non-toxic; dosage control and application of additive are described and illustrated. Process Bulletin "C2." *Nalco Chemical Co., Advertising Dept., 6216 W. 66th Place, Chicago 38, Ill.*

▶ *WELDING DATA BOOK* — seventh edition of 148 page maintenance publication includes new application and design data; provides guide, indexed by application, to nearly 200 different welding rods, electrodes, and chemical aids; illustrates and explains general welding techniques and joint design hints; elimination of warping, distortion, embrittlement, and other base metal damage explained; information on obtaining improved wear, impact, corrosion resistance, color match, and machinability of welds also given. *Eutectic Welding Alloys Corp., Flushing, N.Y.*

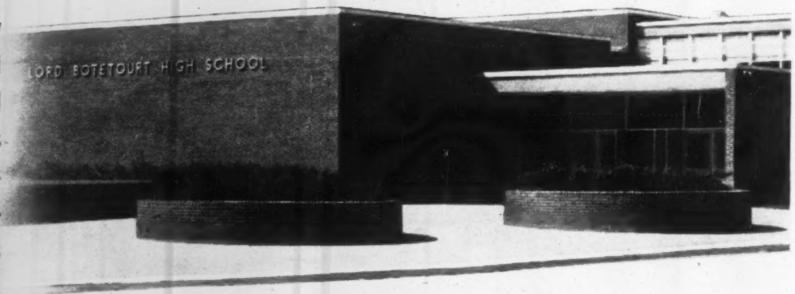
▶ *WELDING ELECTRODES* — 20 page illustrated booklet "NH-504" gives AWS and ASTM specifications for mild, low alloy, and stainless steel electrodes; chemical requirements for all weld metal given; outlines eight points to consider in choosing correct mild steel electrode, and lists NEMA standard identification markings for electrodes; standard welding symbols summarized. *National Cylinder Gas Div., Chemetron Corp., 840 N. Michigan Ave., Chicago 11, Ill.*

LEADING ENGINEERS SPECIFY A MODERN STOKER*

Two 500 lb. per hour Combustioneer stokers were installed in this beautifully modern Virginia high school after coal was recommended and Combustioneer stokers were specified by the leading firm of Hayes, Seay, Mattern and Mattern, architects and engineers.

Combustioneer gives automatic firing and coal provides for greatest economy in heating.

*COMBUSTIONEER STOKER INSTALLATION
LORD BOTETOURT HIGH SCHOOL
BOTETOURT COUNTY, VIRGINIA



Architects and Engineers:
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ROANOKE, VA. • NORFOLK, VA.
WASHINGTON, D. C.

BITUMINOUS COAL EQUIPMENT, INC.
Indianapolis, Indiana

WE HEAR THAT...

▶ *HEAT RECOVERY CORP.* has been formed to market a heat exchanger designed to recover heat from contaminated air, or cool incoming air for air conditioned or refrigerated space. Located in Newark, N.J., the firm is headed by H. H. Paltridge, president, Walter Kempf, vice president and sales manager, and Daniel Moretti, treasurer.

▶ *BARRY WRIGHT CORP.* has been formed with the consolidation of *BARRY CONTROLS INC.* and *THE WRIGHT LINE.* R. Perry Collins was named chairman of the board, and Ervin Pietz was named president and chief executive officer. Headquarters will be located in Watertown, Mass.

▶ The name of the west coast operation of *PENN CONTROLS, INC.* has been changed to *PENN CONTROLS, INC., WESTERN DIV.* The division occupies a new building in Costa Mesa, Calif.

▶ *ALLIED METAL HOSE CO.* has formed its *HEATING, AIR CONDITIONING, and PIPING DIV.* to service mechanical contractors, engineers, consultants, and others who use flexible connectors. The division is located in the firm's plant in Long Island, N.Y.

▶ *CARRIER AIR CONDITIONING CO.* will rebuild hermetic compressors in sizes from two to 15 hp in a new assembly operation to be established in Houston, Tex., this year. New facilities will speed delivery and reduce freight costs for the area west of the Mississippi.

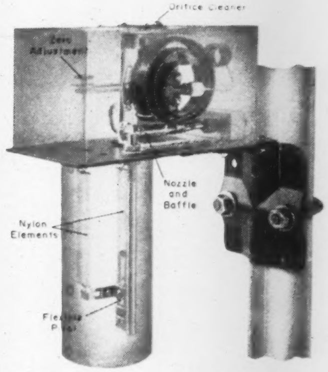
▶ *WHITE-RODGERS CO.*, St. Louis automatic controls manufacturer, has acquired the assets of the *BURNER DIV., CONFIGURED TUBE PRODUCTS CO.*, of Bellwood, Ill.

▶ *T. B. FOCKE* has retired as vice president and general manager, and *JOHN C. HAAS* has retired as executive assistant to the vice president of the *PLUMBING - HEATING - AIR CONDITIONING GROUP of CRANE CO.* Mr. Haas leaves with 50 years of service.

▶ *YORK DIV. of BORG-WARNER CORP.* has sold its West York plant to Hofmann Industries Inc., Sinking Springs, Pa., for industrial development.

New FROM Taylor

No. 207T RELATIVE HUMIDITY TRANSMITTER



Phantom View of Room Model

Simple. A non-indicating, pneumatic, motion-balance transmitter, the No. 207T produces an air output pressure proportional to the relative humidity around the sensing elements, permitting a direct reading in the receiving instrument.

Easy to adjust. Zero setting can be checked by comparing the output with relative humidity determined by a wet and dry bulb hygrometer. Adjustment is by means of a knurled nut on the Bourdon spring take-off arm.

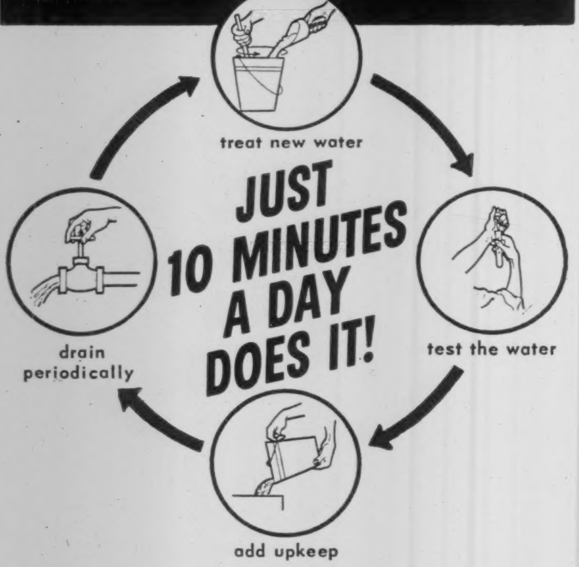
Easy to maintain. Nylon elements, nozzle-baffle system and Bourdon spring element are easily accessible; stainless steel nozzle simply removed for cleaning; finger-tight tubing connections.

Write for
Bulletin 98338

Taylor Instrument Companies
Rochester, New York, and Toronto, Ontario

Taylor Instruments
MEAN ACCURACY FIRST

How to simplify
air conditioning system
water treatment



Here's servicing of air conditioner water in the easiest possible way. A routine 10 minute daily check by one man, and Oakite Airefiner No. 52 ... that's all it takes. You end scale, slime, algae and corrosion troubles. You avoid out-of-service time, and maintain cooling efficiency.

The entire operation is simplicity itself. (1) Charge water initially with economical Oakite Airefiner No. 52. (2) A simple once-a-day check of water tells whether any adjustment is needed. (3) Add upkeep, if necessary. (4) Periodically, drain system and replenish with fresh, charged water.

Oakite Airefiner No. 52 leaves no deposit on tubes, is safe, and costs little for initial charge as well as upkeep.

Call in the local Oakite Technical Service Representative to get details and drawings on this money- and trouble-saving procedure. Or write Oakite Products, Inc., 32D Rector Street, New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS · METHODS · SERVICE
SCIENCE
Export Division
Cable Address: Oakite

specialized
WATER TREATING
materials

Technical Service Representatives in Principal Cities of U. S. and Canada

WE HEAR THAT

Continued

▶ *HUPP CORP.* has acquired for cash all outstanding stock of *E. ROY INDUSTRIES LTD.*, and will operate the Montreal Canada firm as a subsidiary.

▶ *ROBBINS & MYERS, INC., PROPELLAIR DIV.*, has inaugurated operations in its new fan testing wind tunnel in Springfield, O.

▶ Four divisions of the *AMERICAN GAGE & MACHINE CO.* have acquired new plants. *CHAMPION PNEUMATIC MACHINERY CO.* added a 50,000 sq ft plant on six acres in Princeton, Ill.; *AFFILIATED SCREW PRODUCTS CO.*, a 50,000 sq ft plant on five acres in Schiller Park, Ill.; *SIMPSON ELECTRIC CO.* added plant No. eight to its facilities in Lac du Flambeau, Wis.; and *STANDARD TRANSFORMER CO.*, a 40,000 sq ft plant in Elgin, Ill.

▶ *THE BRISTOL CO.* has moved its midwest branch factory and offices from Chicago to enlarged quarters at 2040 N. Hawthorne Ave., Melrose Park, Ill.

▶ *THE HEINEMANN ELECTRIC CO.* has moved into a new and larger plant in Trenton, N.J. The building houses the firm's main administrative and sales offices, and expanded test facilities.

▶ *CYLINDERS, INC.* has purchased machinery from the *LINDE CO.* for manufacturing cylinders for propane, refrigerant, and anhydrous ammonia service. The firm expects to be shipping from its Linden, N.J. plant by February 1, 1961. Linde has halted production of these products.

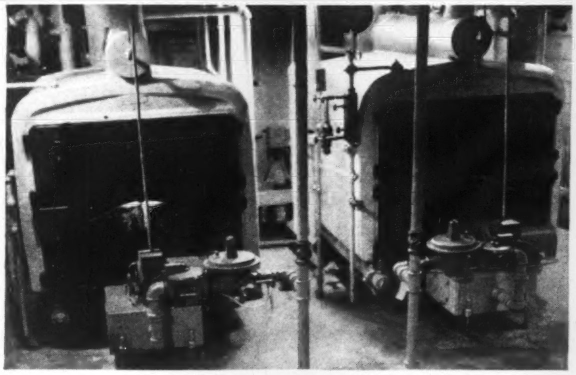
▶ *MINNEAPOLIS-HONEYWELL REGULATOR CO.* has announced plans for a *SPECIAL SYSTEMS DIV.* to advance the technology of complex integrated control systems. Specific functions will include research, design, fabrication, development, installation, and checkout of specialized control systems, in addition to coordinating the activities of other divisions in the design and fabrication of components for these systems.

▶ *WESTINGHOUSE ELECTRIC CORP.* has adopted the name of *WEST-ING-ARC* for its welding department. The firm feels that the name identifies the broadening activities of the department more readily.

Swiss Chancery Building, Washington, D.C.

LO-BLAST

POWER GAS BURNERS SELECTED FOR SWISS CHANCERY



A pair of No. 5N-4 Lo-BLAST Burners supply 2,000,000 BTU/hr. each

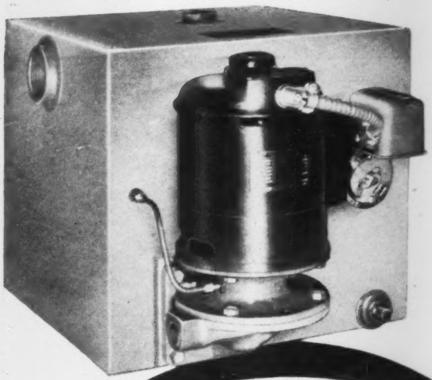
Lo-BLAST Power Gas Burners were selected for this installation *because they eliminate the fuel waste caused by uncontrolled draft!*

The Lo-BLAST Burner uses an extremely quiet, low speed blower to provide perfectly controlled primary and secondary air. Operation is always independent of natural draft conditions—when the burner shuts off, the flow of air stops, permitting the heating plant to retain much of its heat. Combustion is completed in an incandescent firebox, with radiant heat applied to the crown sheet as well as side walls.

Lo-BLAST eliminates the need for high chimneys —"inshot" design cuts maintenance—complete factory assembly reduces installation costs. Each unit is factory tested on gas before shipment.

Lo-BLAST and Economite Power Gas Burners are available in capacities from 75,000 to 20,000,000 BTU/hr. Write for literature.

MID-CONTINENT
METAL PRODUCTS CO.
1960 N. CLYBOURN AVE., CHICAGO 14, ILLINOIS



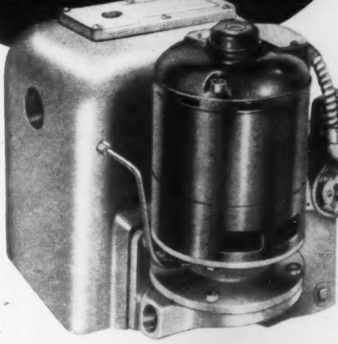
4100 Series STEEL TANK

Efficient in operation . . . neat and compact in design. Easy to service . . . all principal parts — motor, pump, float switch, drain plug — at front of tank.

Sterlco®

low pressure condensate pumps

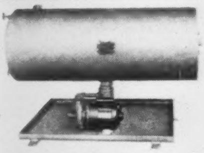
CAPACITIES: 2000 TO 15,000 SQ. FT. E.D.R.



4200 Series CAST IRON TANK

Exactly the same design and performance as the 4100 series, except for cast iron tank where necessary or desirable.

Sterlco pumps are specially engineered . . . they are not adaptions of industrial or water supply pumps. Both series can deliver full rated output continuously, for long periods. Efficient impeller design prevents serious overloading of motors under any conditions.



SPECIAL APPLICATIONS — *For boiler return systems, greater capacities, or higher pressures, the 3500 series is available. It can be built to handle any job.*

Ask your plumbing and heating distributor, or write us for complete information!

Leaders in temperature controls since 1916

Sterling inc.
5203 West Clinton Avenue Milwaukee 23, Wis.

WHO'S WHAT . . .

(New personnel, promotions)

▸ *WOLVERINE TUBE, DIV. OF CALUMET & HECLA, INC.* — L. A. Brewer, manager of sales administration.

▸ *CARRIER INTERNATIONAL LTD.* — John M. Rachal, president.

▸ *UTILITY APPLIANCE CORP.* — Fred B. Hartney Jr., general sales manager of *GAFFERS & SATTLER PRODUCT DIV.*

▸ *MINNEAPOLIS-HONEYWELL REGULATOR CO.* —C. B. Sweatt Jr., agricultural market supervisor, *INDUSTRIAL CONTROLS DIV.*; Kenneth Brierley, general manager, *FALL RIVER, MASS. DIV.*; and John H. Hagen, general manager, *RUBICON DIV.*

▸ *GENERAL KINETICS CORP.* — Lee Tarricone, sales manager.

▸ *METALS DIV. OF OLIN MATHIESON CHEMICAL CORP.* — R. R. Johns, Los Angeles district manager, aluminum field sales.

▸ *MEASUREMENT CONTROL DEVICES* — Paul Cherkas, president.

▸ *BALDWIN-EHRET-HILL, INC.* — Alvin M. Ehret Jr., chairman of the board, and Edward R. Stevens, president.

▸ *L * A WATER CONDITIONING, INC.* — Jay T. Nicholson, vice president and member of the board of directors.

▸ *JAMESBURY CORP.* — Edgar Rothschild, sales coordinator.

▸ *WALWORTH CO.* — Gustav A. Hoffman, vice president, sales.

▸ *AIR MOVING AND CONDITIONING ASSOCIATION* — Irving W. Clark, executive vice president and chief executive officer.

▸ *FRED S. DUBIN ASSOCIATES* — Gene A. Gessner, associate in charge of the mechanical engineering department in New York office; Norman D. Kurtz, engineering administrative assistant.

• A NEW ZONE CONTROL VALVE THAT DARES TO BE BEST •

Hydrozone® outlasts... out-performs other zone valves 12 to 1!

The weight alone tells you that this is a zone control valve that's designed to last a lifetime! Heavier, sturdier . . . Hydrozone® Motorized Valves provide rugged, consistent performance up to twelve times longer than other zone valves.

HYDROZONE
CASH AUTOMATIC VALVES ACME
CLOSED
CASH ACME

COMPACT, UNITIZED CONSTRUCTION • OPERATES IN ANY POSITION • MANUAL OPEN-CLOSE ADJUSTMENT • RUGGED ANGLE VALVE DESIGN • TIGHT-CLOSING SILICONE VALVE SEAT • QUIET OPERATION • LEAK-PROOF SEAL CONSTRUCTION (PAT. PENDING) • DUST-PROOF HEAVY ALUMINUM MOTOR CASE • SELF-ALIGNING, LIFTING STAINLESS STEEL VALVE STEM • LIFE-TIME LUBRICATION • IN-BUILT UNION CONNECTION SUPPLIED

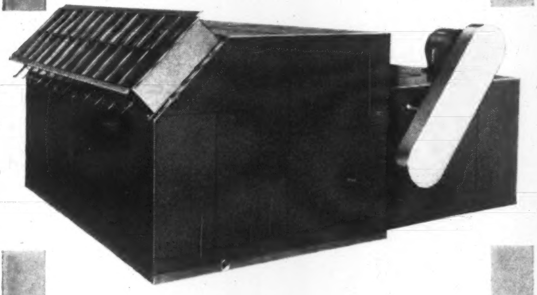
Another quality product of
INDUSTRY'S WIDE, WIDE LINE

A. W. CASH VALVE
MFG. CORP.
666 E. Wabash Ave.
Decatur, Illinois

CASH AUTOMATIC VALVES ACME

USAIRCO

40 years experience in air handling units



Series 75 Multi-Zone Unit

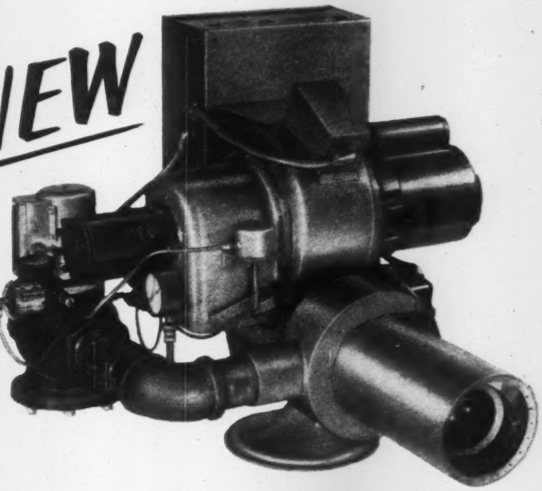
RUGGED CONSTRUCTION

Built for Efficient Performance, Long Life and Trouble-Free Operation

WRITE FOR PRODUCT BULLETIN 75

United States Air Conditioning Corporation
Delaware, Ohio

NEW



SPACE-SAVING EFFICIENCY & FLEXIBILITY

with the Roberts-Gordon "CYCLO-JET"

Here's the hottest news in years for commercial and industrial heating! Roberts-Gordon's *new*, complete line of "Cyclo-Jet" power pressure burners achieves a unique concept of peak efficiency fuel combustion in a truly compact package. It's the all-new "Cyclo-Jet" burner head that does it!

- **Positive Combustion Air Control Insures Maximum Fuel Economy**
- **Uniform, Compact Flame Pattern over Wide Firing Range**
- **Completely Automatic Control System**
- **Gas, Oil or Dual Fuel Gas/Oil Models**
- **Capacities to 2,600,000 BTU's/hr. input**

Factory assembled and tested, the "Cyclo-Jet" Burner is a *complete* fuel burning device and control system. Combining high efficiency with great compactness, the new "Cyclo-Jet" Burner Head is extremely flexible and simple to install.

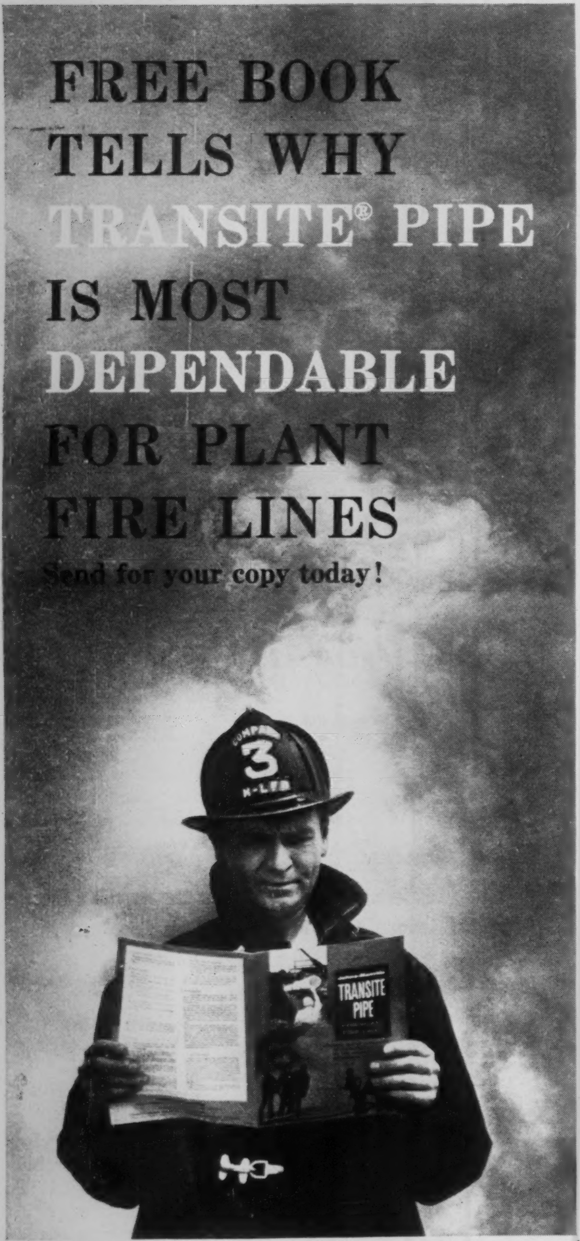
Unique design of burner head forces gas and air into combustion chamber with cyclonic turbulence. This gives compact flame configuration with resulting high heat release, facilitating firing of equipment normally presenting difficult combustion problems.

Accurate combustion air control with either fuel eliminates need for induced draft fan or tall chimney. Fixed firing rate, two-stage or fully modulating gas control systems are available. Dual gas/oil burners are designed for quick manual or automatic fuel changeover. Low-fire start and pre- and post-purge are optional. Totally enclosed control panel is standard. Panel lights indicate when controls are energized. Electronic-interrupted pilot control system gives safe, positive main flame supervision. Fully factory guaranteed.

Cash In On the Profit Opportunities of the Revolutionary New "Cyclo-Jet" Power Pressure Burner Line NOW! Contact Your Roberts-Gordon Dealer or Write Us Direct.

ROBERTS GORDON

ROBERTS-GORDON APPLIANCE CORP.
44 Central Ave., Dept. HP, Buffalo 6, N.Y.
In Canada — Grimsby, Ontario



JM JOHNS-MANVILLE

Box 14, HP-10, New York 16, N. Y.

Please send me, without obligation, your facts and data book on Transite Pipe for Plant Fire Lines.

NAME__________

ADDRESS__________

CITY__________ZONE__________

COUNTY__________STATE__________

WHO'S WHAT

Continued

▸ *WELBILT AIR CONDITIONING AND HEATING CORP.* — Louis G. Burkhart, district sales manager for western and upstate New York, eastern Ohio, and northwestern Pennsylvania.

▸ *AMERICAN TUBE & CONTROLS, INC.* — D. H. Meader, advertising manager.

▸ *AMERICAN GAS ASSOCIATION* — Lester B. Inglis Jr., assistant secretary, *OPERATING SECTION.*

▸ *PERMACEL, DIV. OF JOHNSON & JOHNSON* — George A. Fitzgerald, president, and Robert S. Bradford, vice president, sales.

▸ *BOHN ALUMINUM AND BRASS CORP.* — Lawrence E. Jennings Jr., product manager, commercial department. *DANVILLE* (Ill.) *DIV.*

▸ *RAYTHEON, COMMERCIAL APPARATUS AND SYSTEMS DIV.* — Kenneth E. Glover, manager of new business development.

▸ *L. J. WING MFG. CO., DIV. OF AERO SUPPLY MFG. CO., INC.* — Adolph R. Schaub, vice president of manufacturing.

▸ *CHRYSLER CORP., AIRTEMP DIV.* — Joseph V. Weigle, field sales manager, applied machinery and systems dept., and George B. Sharkey, responsible for all national account, government, builder, and utility sales for the special markets dept.

▸ *THATCHER FURNACE CO.* — Russell M. Cook, president.

▸ *COPELAND REFRIGERATION CORP.* — T. W. Phelps and Edwin L. Gannaway, assistant chief engineers.

▸ *AMERICAN-STANDARD INDUSTRIAL DIV.* — Graeme B. Supple, director, product development, air conditioning systems.

▸ *DEARBORN CHEMICAL CO.* — Lewis I. Terry, laboratory manager.

Another FIRST from...

DURO DYNE

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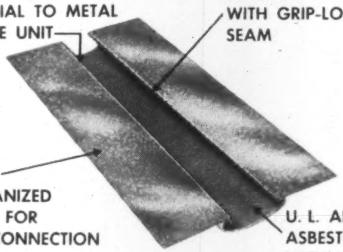
Asbestoseal

A NEW FLEXIBLE CONNECTOR MATERIAL ALREADY ACCLAIMED

"The Ideal Connector for Furnace Installations"


PREASSEMBLED MATERIAL TO METAL IN ONE UNIT
SECURELY LOCKED WITH GRIP-LOC SEAM
AMPLE GALVANIZED METAL FOR ANY CONNECTION
U. L. APPROVED ASBESTOS SEALED WITH NEOPRENE

ECONOMICAL By combining all of the advantages of Canvas, Asbestos and Neoprene into one, ASBESTOSEAL offers greater economy in use.

HEAT-RESISTANT Made of Underwriters Grade Asbestos, especially suitable for high temperature applications.

NON-POROUS Sealed tight with fire-resistant Neoprene coating, withstands toxic fumes.

SECURELY LOCKED ASBESTOSEAL combines Duro-Dyne's new Grip-Loc with the proven and tested Double-Loc seam and offers unsurpassed holding power.

CONTINUOUS COILS Uncoils flat from its handy, bench-high dispenser carton ready to be marked, cut, notched or bent. Generous metal dimensions of ASBESTOSEAL enable the contractor to form any type of connection easily, quickly and profitably.

SEND FOR FREE SAMPLE NOW!

DURO DYNE CORP.
FARMINGDALE, NEW YORK
Manufacturers of
DRILL SCREWS—DAMPER REGULATORS AND QUADRANTS — BLADE KITS — INSULATION ADHESIVE — PORTABLE SPOT WELDERS

GRID's *got to be good!*

ABBOTT LABORATORIES
ALLEGHENY LUDLUM
MERCK & CO., INC.
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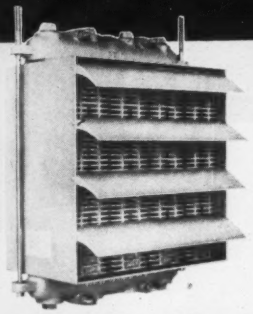
UNITED STATES STEEL
GEO. A. HORMEL CO.
DIAMOND ALKALI CO.
GENERAL MOTORS
JONES & LAUGHLIN
DOW CHEMICAL CO.
AMERICAN BRASS CO.
JOHNS-MANVILLE
A.T. & S.F.R.R. CO.



The best guarantee any product can have is its users.

LOOK
at the plants
that depend upon

GRID ▶ UNIT HEATERS BLAST HEATERS RADIATORS

for a trouble-free, low maintenance cost heating system - One that will serve without service - Installations made in 1929 are still operating without need for repairs. GRID'S design and construction makes the difference!

GRID Cast Iron Construction resists corrosion externally from acid fumes and internally from electrolysis. No leaking from rotted cores.

GRID one-piece cast iron heating sections and headers are leak-proof on steam pressure up to 250 p.s.i. 450° temperature. Smaller steam lines cost less.

GRID heating sections with widely spaced fins cast integral with steam chambers are easy to clean - Will not "mat" on air intake side.

GRID design develops low outlet temperatures and, with proper fan volumes, delivers warm, comfortable air to floor - No wasted heat at ceiling.

Get complete information on a GRID System for your plant. Write for catalog #956 GRID CAST IRON STEAM HEAT TRANSFER SURFACE.

Representatives in principal cities

BAKELITE CO. CELOTEX CORP.
B & O R.R. CMSTPP&P RR
EVERETT PULP & PAPER CO. VICTOR CHEMICAL WORKS
GENERAL ANALINE & GENERAL CHEMICAL DIV. CUDAHY PACKING CO.
AMERICAN CHAIN & CABLE SWIFT & CO. WHEELING STEEL CORPORATION
AMERICAN CYANAMID CO. H. J. HEINZ CO. INTERNATIONAL SHOE CO.
ARMCO STEEL CORP. CONSOLIDATED MINING & SMELTING CO., LTD.
ARMOUR & CO. SINCLAIR REFINING CO. CARNEGIE ILLINOIS STEEL CO.
AMERICAN STEEL & WIRE CO. COLUMBIA SOUTHERN CHEMICAL CORP.
ANACONDA COPPER MINING CO. OLIN-MATHIESON CHEMICAL CORP.
ANSUL CHEMICAL CO. UNITED ELECTRIC COAL CO. NATIONAL LEAD CO.
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ALLIS-CHALMERS MFG. CO. SHARPLES CHEMICALS NAUGATUCK CHEMICAL
AMERICAN MACH. & FOUNDRY CO. WEST VIRGINIA PULP & PAPER CO.
AMERICAN RADIATOR & STD. SAN. LITHIUM CORP. MORTON SALT CO.
ANCHOR HOCKING GLASS CORP. HERCULES POWDER FALK CORPORATION
GENERAL FOODS CORPORATION PENNSYLVANIA SALT MFG. CO.
GENERAL ELECTRIC CO. U. S. RUBBER CO. PHILLIPS PETROLEUM CO.
INLAND STEEL GREAT NORTHERN RAILWAY WASHINGTON TERMINAL CO.
ILLINOIS CENTRAL R.R. CO. WESTINGHOUSE UNION CARBIDE & CARBON
MINNESOTA MINING & MFG. CO. E. I. DuPONT de NEMOURS INC.
NEW YORK CENTRAL R.R. ELECTRIC AUTO LITE CO. MASONITE CORP.
CANADIAN PACIFIC RWY. CO. YOUNGSTOWN SHEET & TUBE CO.
KRAFT FOODS GENERAL TIRE & RUBBER CO. INTERNATIONAL PAPER CO.
CHAIN BELT CO. A. O. SMITH CORPORATION BETHLEHEM STEEL CORP.
CHESAPEAKE & OHIO R.R MONSANTO CHEMICAL CO. BENZOL PRODUCTS
MAINE CENTRAL R.R. CO. NORTHERN PACIFIC R.R. CO. BENDIX CORP.
CHICAGO NORTH WESTERN R.R. STANDARD OIL CO. FORD MOTOR CO.
CHRYSLER CORP. WILLPUTTE COKE OVEN DIV. DIAMOND ALAKALI CO.
CLIFFS DOW CHEMICAL CO. BUCKEYE COTTON OIL CO. B. F. GOODRICH
MARATHON CORPORATION HOFFMANN La-ROCHE INC. BEATRICE FOODS
CARNEGIE ILL. STEEL CORP. DAVISON CHEMICAL CORP. GOODYEAR
FAIRMONT FOODS CO. HARSHAW CHEMICAL CO. STAUFFER CHEMICAL
FOOD MACH. & CHEM. CORP. INTERNATIONAL HARVESTER BORDEN CO.
NATIONAL CONTAINER MINN. & ST. LOUIS R. R. CO. LOUIS ALLIS CO.
CONSOLIDATED WATER POWER & PAPER CO. SINCLAIR REFINING CO.

D. J. MURRAY MANUFACTURING CO.
Manufacturers Since 1883
WAUSAU, WISCONSIN

WHO'S WHAT

Continued

▶ *THOMSON ELECTRIC WELDER CO.* — C. Dana Moore, sales manager, John C. Grant Jr., assistant sales manager, and George R. Grant, factory sales engineer.

▶ *BETTER HEATING-COOLING COUNCIL* — Fred D. Richard, director of field services.

▶ *THE NORTH AMERICAN MOGUL PRODUCTS CO.* — William T. Sullivan, director of marketing and general sales manager; George P. Loomis Jr., director of service and product research and development.

▶ *BABCOCK & WILCOX CO.* — Edward L. Ogden, director of employee relations.

▶ *WORTHINGTON CORP., AIR CONDITIONING DIV.* — Wilbur C. Smith, chief engineer of development, single stage centrifugal systems, and A. J. Van Newenhoven, chief engineer, reciprocating compressors.

▶ *KEASBEY & MATTISON CO.* — Ralph L. Lanz, vice president, materials, and member of the board of directors.

▶ *CARRIER CORP.* — William E. Hood, chief engineer, unitary equipment operation.

▶ *YOUNG RADIATOR CO.* — Forest D. Richardson, treasurer in charge of finance and business administration.

▶ *CATAWISSA VALVE & FITTINGS CO.* — Craig L. Davis, president.

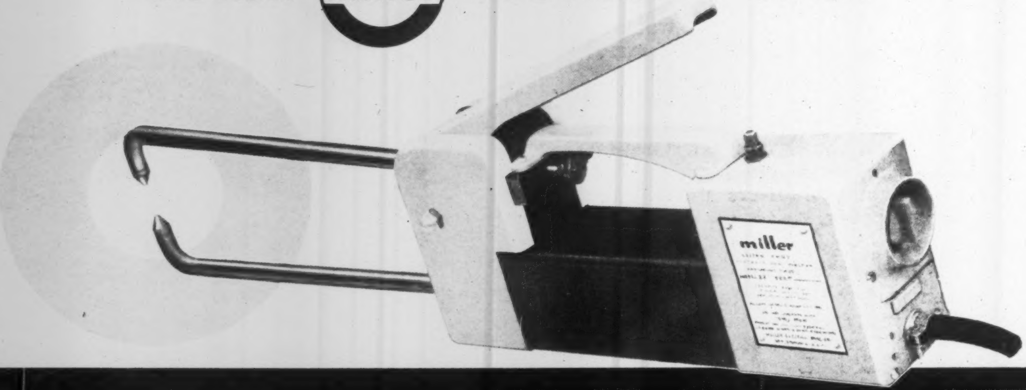
▶ *CONTROLS CO. OF AMERICA* — Joseph H. Schellman, general manager of the *CONTROL SWITCH DIV.* has been elected vice president.

▶ *HAUCK MFG. CO.* — Joseph E. Zwit, sales manager, *ENGINEERING DIV.*

▶ *YORK DIV. OF BORG-WARNER CORP.* — Henry H. Kirkpatrick, manager of advertising and sales promotion, and Kenneth J. Thompson, sales promotion manager for all York divisions.

Hottest "Spot" in the Shop

the NEW miller LECTRO SPOT



Simply depress lever and tongs grip metal at pre-determined pressure, switch is turned on and weld sequence timer is actuated for precise period set on control dial. Thus, every weld is identical until timer adjustment is changed. Pilot light indicates when welder is connected.

This advanced design plus light weight and wide selection of tongs make the new Miller Lectro Spot the finest welder of its type.

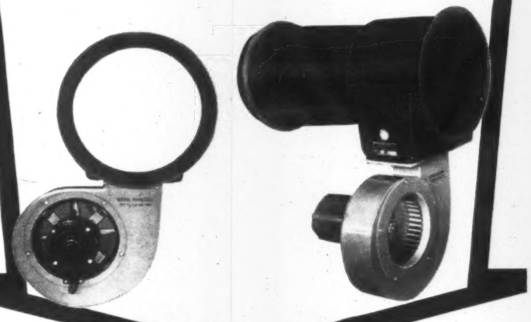
Available in three styles: 115v or 230v, 1.5 KVA models for work to 1/8" thickness, both weigh 29 lbs.; 230v, 2.5 KVA model for mild steel to 5/32", weighs 37 lbs.

Complete specifications with tong and tip availabilities will be sent promptly upon request.

miller ELECTRIC MANUFACTURING COMPANY, INC. • Appleton, Wisconsin

Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

FOR MAXIMUM HEATING OR EXHAUSTING EFFICIENCY AT LOWEST COST



...Specify

Patents 2,722,372 and 2,855,874 and Patents Pending plus Exclusive Foreign Patents.

Quickdraft

POWER-DRAFT UNITS DESIGNED FOR RESIDENTIAL, COMMERCIAL AND INDUSTRIAL APPLICATIONS

★ No motors, fans or bearings in exhaust line ★ Needs no stacks ★ Acid-resisting vitreous enamel finishes ★ Extremely high static pressures now available

FOR HEATING PLANTS AND INCINERATORS . . . *Quickdraft* provides constant draft for efficient and economical combustion. It eliminates pulsating or chattering, puffing, smoking and sooting. Costly, tall, unsightly stacks are unnecessary.

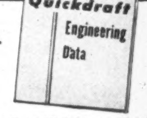
FOR INDUSTRY . . . *Quickdraft* now offers extremely high static pressures for EXHAUSTING corrosive gases, abrasives and paint sprays . . . for CONVEYING all types of bulk materials or wastes that can be moved by air.

FOR MOVING AIR in or out of buildings through ducts . . . *Quickdraft* is outstanding in performance and efficiency.

9010-QD

IMPORTANT NOTICE

To withstand corrosive gases, all *Quickdraft* units are available in standard acid-resisting vitreous enamel, No. 316 Stainless Steel, rigid plastics (P. V. C.) and with plastic and Fiberglass coatings.



Write today for Quickdraft Engineering Data.

Quickdraft
CORPORATION P. O. BOX 87-K, CANTON 1, OHIO

Great names—that made scientific filtration possible!

Boyle's Law:

$$\frac{V1}{V2} = \frac{P2}{P1}$$

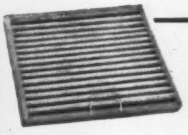
"If the temperature remains constant, the volume of a gas is inversely proportional to the pressure."

Robert Boyle (1627-1691)

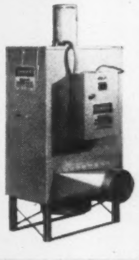
Liquid and gas filtration has been the specialty of Air-Maze for the last 35 years. Yet Boyle's 270 year old discoveries relating to the compression and expansion of air and other gases must be recognized and taken into consideration by our engineers in designing new equipment to keep modern machinery operating efficiently.

From diesel engines to jet aircraft . . . from lubricating oil filters to industrial pumps, filtration products by Air-Maze are keeping equipment running better and longer by keeping it clean and free of destructive contaminants.

The representative products shown below were designed and developed by Air-Maze engineers to solve highly specialized filtration problems. If your product involves any gas or liquid that moves, Air-Maze engineers can help you.



Only Air-Maze P-61 Permanent Dry Type panels combine extended area with water-washability. Result: lower resistance, greater dirt holding capacity.



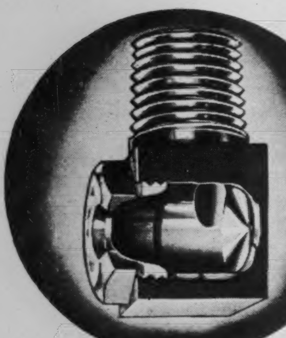
Misti-Maze electronic oil mist and fume eliminator permits air recirculation, reducing heating or cooling load. Ideal for machining or welding operations. Includes motor and exhaust fan.

OTHER AIR-MAZE PRODUCTS:
Air Filters • Liquid Filters • Intake Silencers • Exhaust Spark Arresters Breather Filters • Oil Mist Eliminators

AIR-MAZE®
CLEVELAND 28, OHIO
A SUBSIDIARY OF ROCKWELL-STANDARD

ROCKWELL R STANDARD

Monarch



NOZZLES
for
AIR WASHERS

These are "non-clogging" nozzles with a single large tangential lead hole to the swirl chamber that will never clog from any impurities small enough to pass through the orifice. Swirl chamber is conical on both ends and pivots liquid like a top to produce an exceptionally fine, evenly distributed, balanced spray of about 80° included angle. Wider spray angles up to 130° can be furnished to order.
Standard material Brass. Also available in Stainless Steel and Monel. Pipe sizes from 1/8" to 1". 1/4" size is 1-5/16" long and made from 5/8" square stock.

Write for Catalog 1

Monarch MFG. WORKS, INC.
2523 E. ONTARIO ST.
PHILADELPHIA 34, PA.
Canadian Agents: (Except B. C.)
E. S. Gallagher Sales Ltd., Toronto 12, Canada

KEY-TITE®
SEALS
BEST
KEY-TITE
WATER PROOF
PIPE
JOINT
COMPOUND

Seals tight, lubricates as it seals. For water, gas, low pressure lines. Safe for potable liquids. Pints, quarts, gallons, 5-gallon cans; 500-lb. drums.

WRITE FOR CIRCULAR 239-B

W-K-M DIVISION OF ACF INDUSTRIES INCORPORATED
Dept. BB-10, P. O. Box 2117, Houston, Texas

KT 6001R

MEETINGS & CONVENTIONS

OCT. 12-15—*Cast Bronze Bearing Institute and Non-Ferrous Founders' Society annual meetings.* Grove Park Inn, Asheville N.C. Information: Non-Ferrous Founders' Society, 1604 Chicago Ave., Evanston, Ill.

OCT. 17-21—*48th Annual National Safety Congress.* Industrial safety sessions, Conrad Hilton, Pick-Congress, Sheraton Towers, Morrison, and La Salle hotels, Chicago. Information: R. L. Forney, secretary, National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

NOV. 19-22—*Refrigeration and Air Conditioning Contractors Association 15th Annual Convention.* Fontainebleau Hotel, Miami Beach, Fla. Information: RACCA, 1028 Connecticut Ave., N.W., Washington 6, D.C.

NOV. 27-DEC. 2—*American Society of Mechanical Engineers Winter Annual Meeting. Statler Hilton Hotel, New York, N.Y.* Information: ASME, 29 W. 39th St., New York 18, N.Y.

NOV. 28-DEC. 2—*24th National Exposition of Power and Mechanical Engineering.* Under auspices of the American Society of Mechanical Engineers. New York Coliseum. Information: International Exposition Co., Inc., 480 Lexington Ave., New York 17, N.Y.

DEC. 12-15 — *Industrial Building Exposition and Congress.* New York Coliseum. Information: Clapp & Poliak, Inc., Management, 341 Madison Ave., New York 17, N.Y.

1961

JAN. 23-26 — *National Plant Maintenance & Engineering Show.* International Amphitheater, Chicago. Information: Clapp & Poliak, Inc., Management, 341 Madison Ave., New York 17, N.Y.

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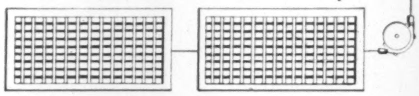

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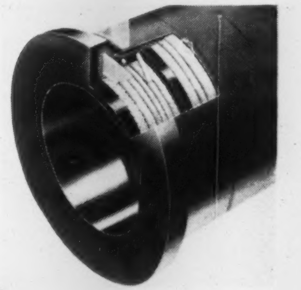

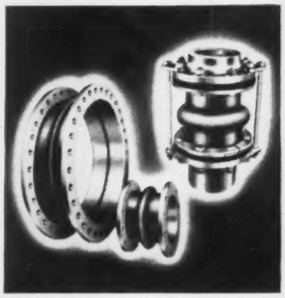

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MEETINGS & CONVENTIONS

Continued

FEB. 13-16 — *American Society of Hearing, Refrigerating and Air-Conditioning Engineers, Inc., semi-annual meeting.* Conrad Hilton Hotel, Chicago, Ill. Information: ASHRAE, 234 Fifth Ave., New York 1, N.Y.

FEB. 13-16 — *International Heating and Air Conditioning Exposition.* International Amphitheater, Chicago, Ill. Information: E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N.Y.

MARCH 27-31 — *Third National Symposium on Temperature — Its Measurement and Control in Science and Industry.* Sponsored by American Institute of Physics, Instrument Society of America, and National Bureau of Standards. Columbus, Ohio. Information: W. R. Tilley, National Bureau of Standards, Washington, D.C.

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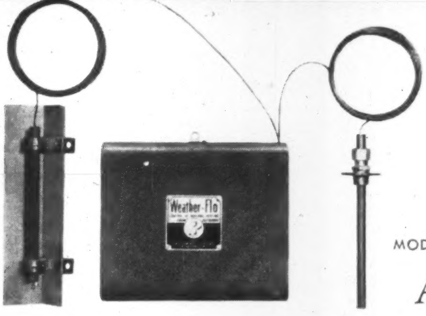

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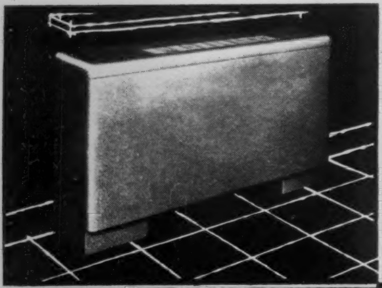

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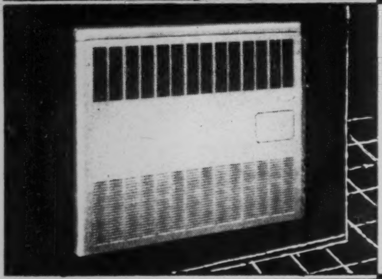

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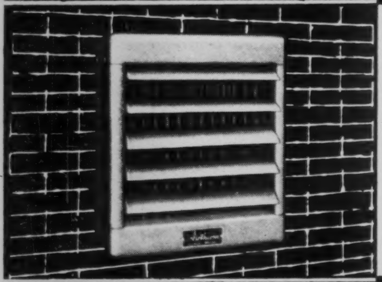

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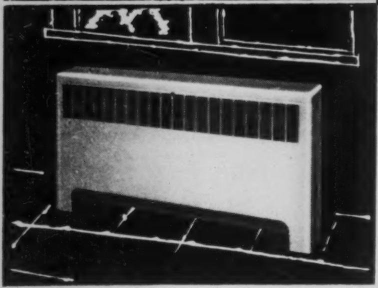

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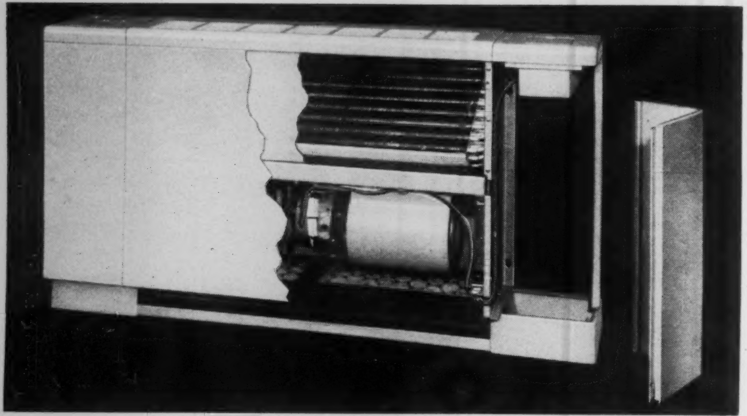

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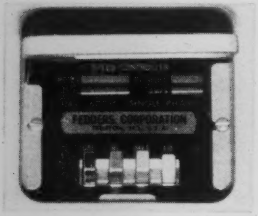

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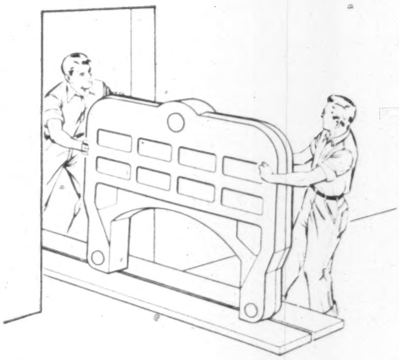

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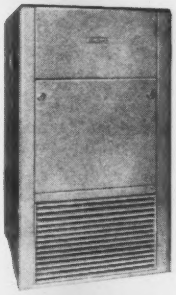

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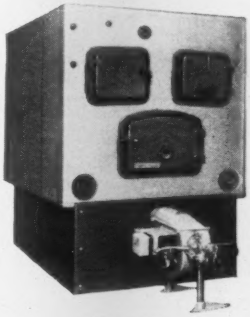

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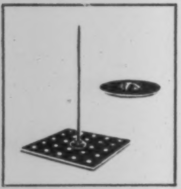
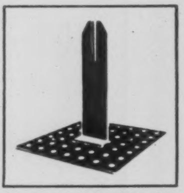


Use Spindle Anchors for bonding fibrous glass batts, mineral wool to ducts, walls, ceilings. Lock washer holds insulation firmly in place.



Use Pronged Anchors for bonding block insulation such as cellular glass. Pronged Anchors are set between rows of blocks and then prongs are bent over.

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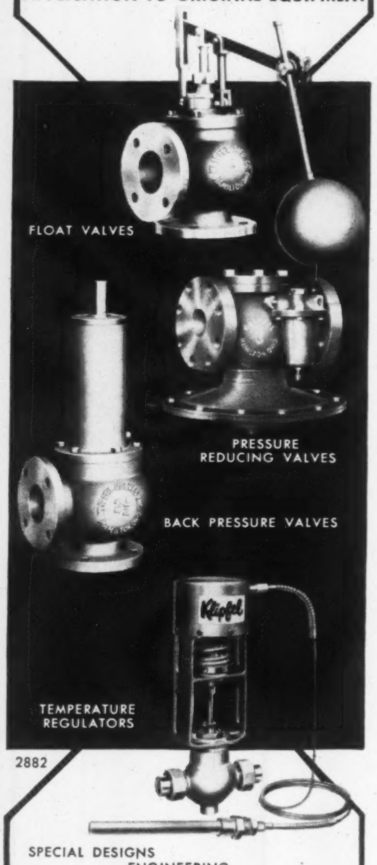

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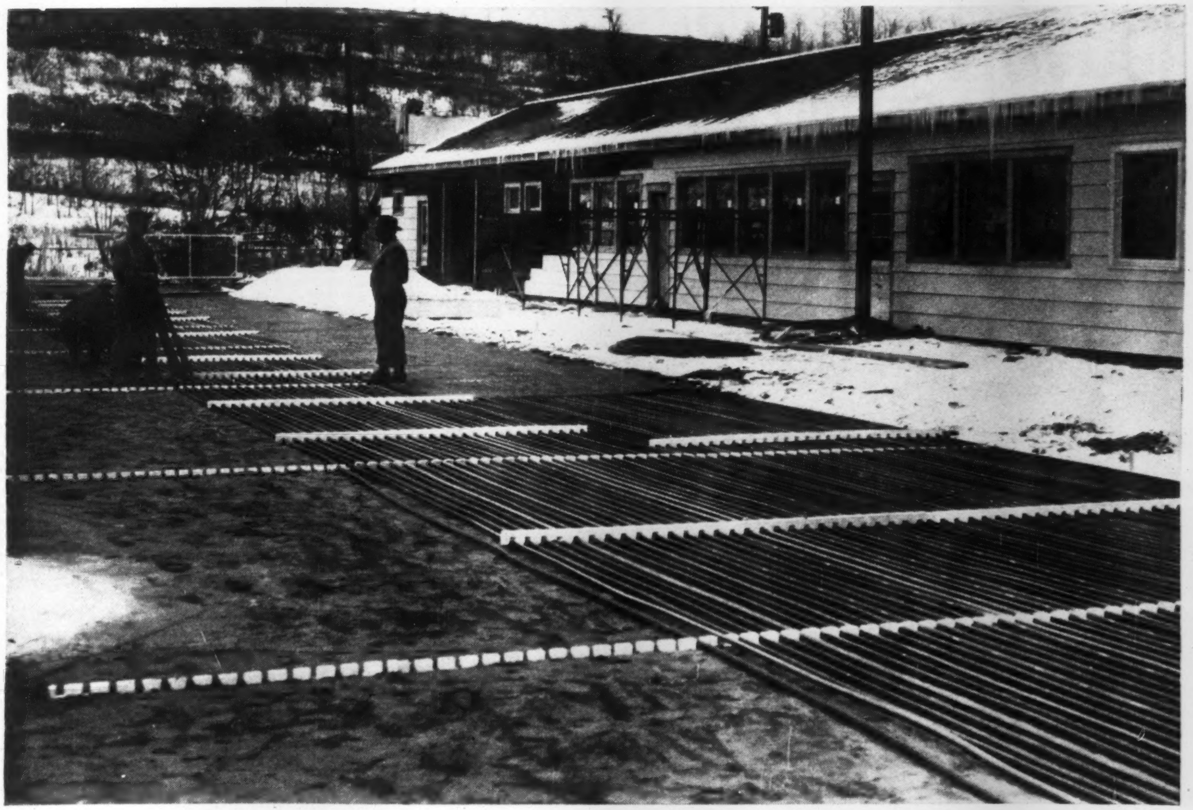

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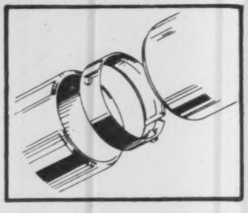

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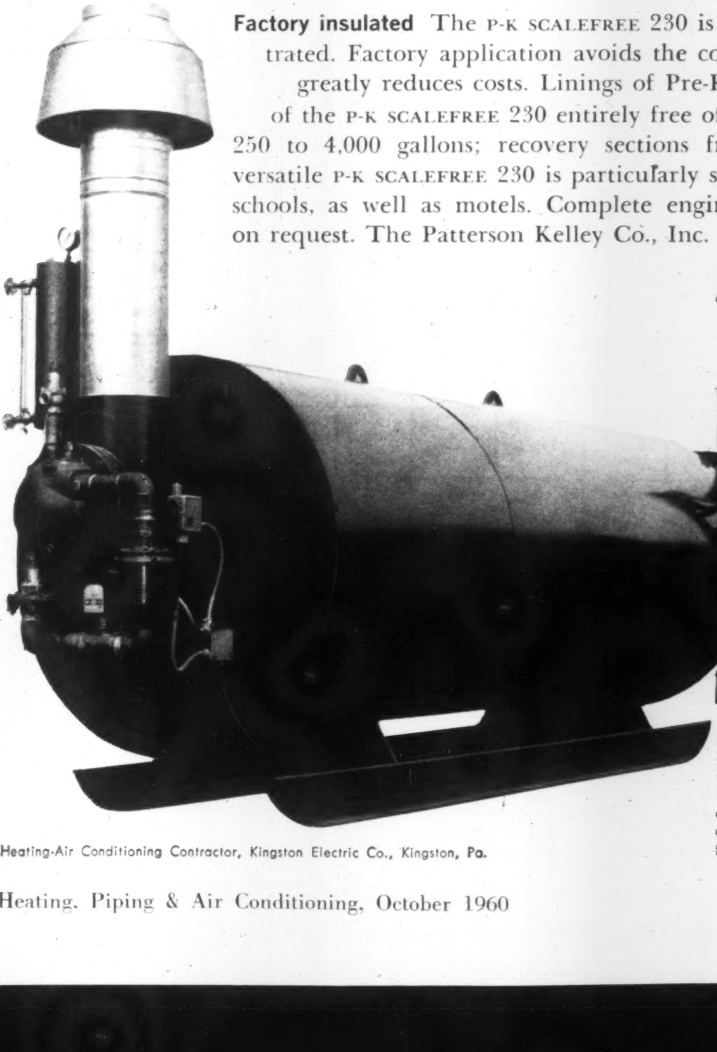

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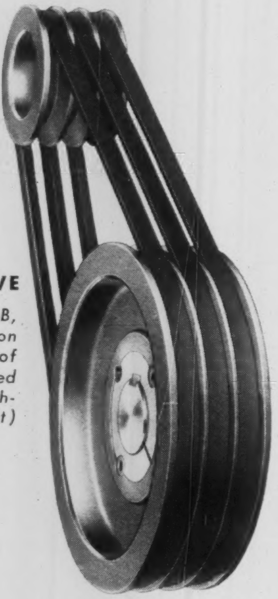

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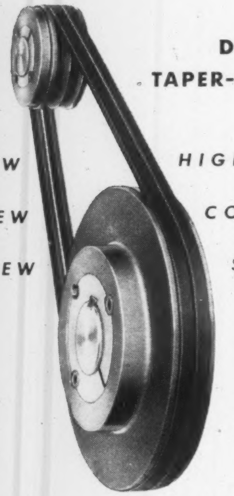

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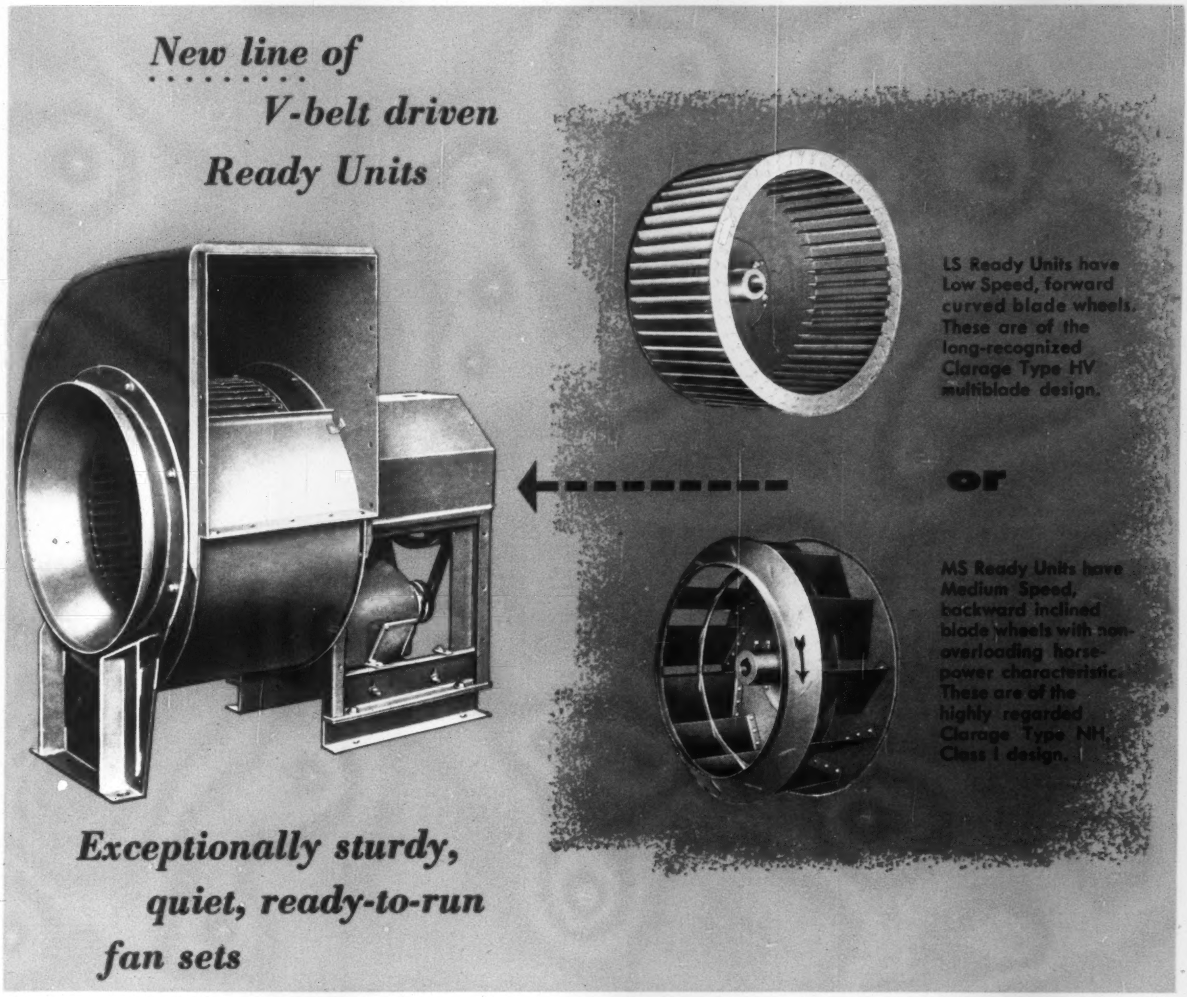

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240-¾ IN.-30	513,000	30 lbs.	¾"	1"
230-1 IN.-30	743,400	30 lbs.	1"	1"
240-1 IN.-30	910,000	30 lbs.	1"	1¼"
230-1½ IN.-30	1,025,100	30 lbs.	1½"	1½"
240-1½ IN.-30	1,560,000	30 lbs.	1½"	2"
240M-3	2,313,000	30 lbs. 36 lbs.	2"	1" 2"
240M-4	2,710,000	30 lbs. 36 lbs.	2"	1¼" 2"
240-2 IN.-30*	3,130,000	30 lbs.	2"	2½"
240-2 IN.-36*	3,550,000	36 lbs.	2"	2½"

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